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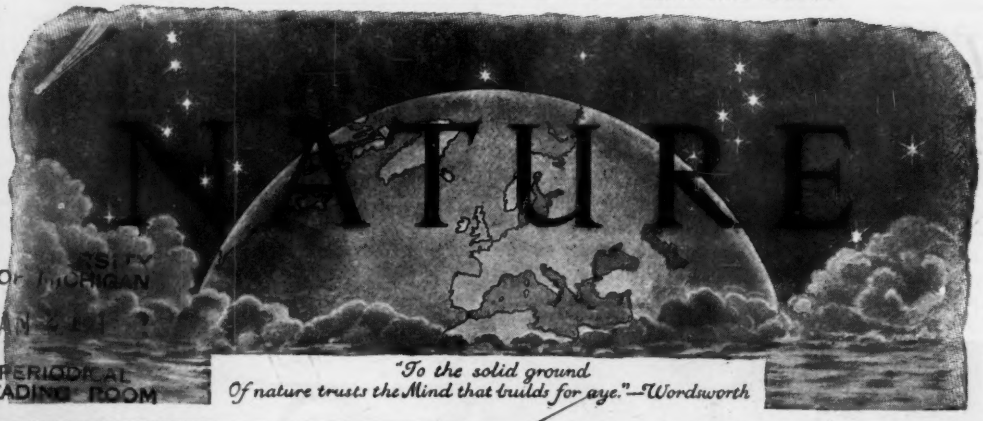

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LEADERSHIP IN THE WELFARE STATE

SEVEN years ago, in "The Price of Social Security", Mrs. Gertrude Williams directed attention to new functions of the trade unions in the social service State under conditions of full employment, as well as to the new demands made on the Civil Service. The late Prof. H. J. Laski, in his book "Reflections on the Revolution of our Time", had already examined some of the implications of social security for the work of trade unions and professional associations, and stressed the part such bodies could play in improving productivity as well as standards of professional practice, of education and of welfare generally.

In conditions of full employment and social security, the protective or negative functions of professional bodies must decline in importance and these positive functions become more significant. The trade unions in Great Britain have, however, shown few signs that they have grasped the significance of this change or the scope of the opportunities for constructive work in fostering technical development and industrial re-organization, and in building and strengthening the new social order opening before them. That the welfare of the members of the trade unions depends in increasing measure on the welfare of the country as a whole has not always been remembered. When Political and Economic Planning published its studies of British trade unionism in 1948, it was recognized that the basic character and aims of the trade union movement were still unaltered: the protection and advancement of the interests of its members were its primary, and sometimes its exclusive, concern, in spite of the experience of co-operation with government and the profound change in the relation of the movement to the rest of society. The studies afforded little evidence that the trade unions were adapting their outlook and practice to the fulfilment of their new role.

This negative outlook persisted in the lectures which Prof. Laski himself delivered in the United States in March–April 1949, just a year before his death. Published last year under the title "Trade Unions in the New Society", these lectures show little trace of the conception of positive functions which Laski had outlined eight years earlier.

To one set of current problems Prof. Laski did direct attention. These are the problems which arise out of the relations of trade unions with nationalized industry. Here he was concerned more especially with the participation of the unions in the management of a nationalized industry. The criteria he suggests are of particular interest in the light of the wider and fuller examination, made recently by the Acton Society Trust, of the practical difficulties which the unions experience once an industry is nationalized and which appear to limit their ability to co-operate in the successful running of the industry, and the implications of nationalization policy for their future role.

Published under the title "The Future of the Unions"*, this is a most disturbing study deserving the attention of all professional bodies having relations with such industries, as well as of those who are concerned with the future and efficiency of productive industry. Even the inter-union problems discussed have their interest for the scientific worker. Such problems have not merely led to disputes over demarcation questions as a result of the efforts of certain nationalized industries to integrate and rationalize their services, or over recognition matters in relation to the 'closed shop': the changed circumstances of former employers and senior executives under nationalization have led to the emergence of what have been termed 'management unions'. Many such men have felt the need for an organization which would represent their interests to the highest level of management and negotiate wage or other agreements. Sometimes professional associations have transformed themselves into negotiating bodies; sometimes new associations have been established for the purpose. But the development which has resulted in the unions representing three main bodies of employees—manual; clerical, technical and administrative; and managerial—has increased the possibility of disputes.

This is notably true in the field of negotiations and joint consultation, nor are the possibilities of friction diminished by the traditional suspicions of the manual workers' unions of clerical and supervisory unions, and now of the new managerial unions. There is little indication that those associations of professional and technical workers which have become affiliated to the Trades Union Congress have been able either to abate such suspicions or instil a more positive and enlightened attitude to present problems.

The modern trade union official must now have sufficient knowledge of the industry to deal with the very wide range of problems which arise in consultation, and he must be able to discuss those questions with management experts instead of merely tabling demands. Defects in union leadership can, in fact, have just as serious repercussions on industrial efficiency as defects in management; but nothing like enough attention has yet been given to this question either inside or outside the unions. It was just indicated by Mr. S. G. Raybould in his recent book "The English Universities and Adult Education"; but the implications for trade unionism of the new educational policy and particularly of the freer access to universities were not considered. No policy of education for leadership, however, can avoid having regard to this issue: it would be fatal to industrial harmony and efficiency if none of the first-rate minds of each generation found their way into the trade union movement or received the intellectual training which enabled them to develop their gifts and use them to the fullest advantage in the service of the unions.

The reason for viewing the situation disclosed by this inquiry with such concern is that little or no attempt has been made by the unions to prepare in advance to meet the difficulties just discussed, and to dispel the lack of realism in the thinking of their members about nationalization and participation in management without having regard to the wider responsibilities involved. The warnings of Laski and others appear virtually to have been ignored, and there is little evidence on the basis of this inquiry that the unions have even begun consideration of the very considerable programme of training and education required.

This, to put it bluntly, is dereliction of leadership, and such dereliction will not fail to bring its own retribution. If the unions, in nationalized industry or elsewhere, continue to ignore the positive aspect of their functions, they may well find themselves unable to exert their traditional protective functions effectively.

The only way in which a union can secure a real increase in wage values for its members is by an increase in efficiency or productivity, or both. The only alternative is an intensifying inflation in which the value of wages increasingly falls behind the advance in prices. Under present conditions, even more than when Laski made the point in his Sidney Hillman lectures, a union in asking for better conditions must establish that there is increased output per man-hour or an obvious increase in the worker's responsibilities in a particular trade, and must put the full emphasis on the first. Only the prompt recognition of these responsibilities and opportunities will enable the unions to safeguard the standards already attained, still more to move from an era of security into one of abundance.

This is essentially a task for the trade unions themselves, and though some union leaders have already shown a clear grasp of what is at stake, the inquiry carried out by the Acton Society Trust provides little evidence that the task is being attempted on a wide basis and will be accomplished in time. The association of the Trades Union Congress with the industrial training courses commenced at Ashridge this year is a much more hopeful sign. Grounds for optimism are also to be found in activities of the Workers' Educational Association, and this Association may well come to play a decisive part in the general educational work which must follow the recognition and analysis of these problems by the unions.

There are other bodies too, like the Acton Society Trust, which can assist in the process by formulating clearly the principles which should govern the relations between management and workers in a nationalized industry, and the series of studies being made by that Trust are clarifying some of the issues and indicating some of the principles which should find acceptance. Studies already made have endorsed the soundness of some of the principles which Laski suggested should govern the management of a nationalized industry, notably in regard to decentralization, to methods of promotion and dismissal, and the provision of adequate organs of consultation for explaining at every level decisions which affect workers, so as to convince them that their views have been seriously weighed before the decisions are given effect.

* Nationalised Industry Series, 8: The Future of the Unions. Pp. iii+32. (Claygate: Acton Society Trust, 1951.) 2s.

The more management can do to make such principles fully operative in industry, to associate workers with the formulation and operation of post-entry schemes of training, with welfare schemes and the like, the easier should be the task of the union officials in educating their members and readjusting ideas and policies. There may be some doubts as to how far it is possible, as was advocated by Laski, to elicit the direct co-operation and understanding of the workers in research, and his last point as to political qualifications for executive office in a nationalized industry is liable to be misconstrued and might well be abused in practice. Neither point should be rejected out of hand and without mature consideration, for both could affect strongly that climate of opinion within and without an industry and so powerfully affect its efficiency. The Acton Society Trust itself in a recent study showed how far we are yet from solving the problem of the right use of scientific and technical experts.

There is thus a whole range of problems to which, from outside the trade union movement, the man of science, the technologist and the administrator can contribute much to help the trade unions to find their solution. Even if the unions are late in recognizing these problems, there is a large measure of goodwill on which they can count. Some scientific workers and professional men are, moreover, members of trade unions and may be able to play a part from within; though this study of the Acton Society Trust leaves it at least a little doubtful whether their influence is likely to be either so effective or so beneficial as when exerted from outside. At least it is clear that professional associations need to clear their minds as to their functions and relations with the nationalized industries, and with other bodies where any attempt may be made to apply the policy of the 'closed shop'. Whatever the general attitude of the scientific worker to membership of a trade union, he should be vigilant to see that his own particular professional associations are awake to all the implications of the new situation, and prepared to make their full contribution to the service of society to-day.

BRAINS AND MACHINES

Doubt and Certainty in Science

A Biologist's Reflections on the Brain. By Prof. J. Z. Young. (The B.B.C. Reith Lectures, 1950.) Pp. viii+168+8 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1951.) 7*s.* 6*d.* net.

THE eight B.B.C. Reith lectures, which Prof. J. Z. Young broadcasted in 1950, have now been published in book form; they deal with the working of the brain, with processes of learning and communication, and with the development of human society. Their title belies both their scope and character. They are not concerned with any abstract discussion of scientific method, nor does Prof. Young try to illuminate empiricist philosophy with lessons drawn from the laboratory. The brain, he points out, is "continually searching for fresh information about the rhythm and regularity of what goes on around us". It is this characteristic of human activity to which he refers as doubting. Once significant new resemblances are found, a "system of law" emerges. When this happens certainty results.

The first lecture sets the stage. Prof. Young, having briefly explained how the man of science works, makes the point that man owes his pre-eminence to the fact that he has developed the power of communication to a far greater extent than have other animals. The cerebral background of this special characteristic is Prof. Young's particular theme, and his exposition is planned so as to avoid the pitfalls of dualism and the use of animistic models. In place of the latter he seeks analogies in the world of man-made machines.

The second, third and fourth lectures deal with the conduction of the nerve impulse and the way the brain functions. Prof. Young introduces the subject of cybernetics, and shows how Dr. Wiener's conception of regulation by 'feed-back' applies to many bodily processes—the analogy being valid in so far as feed-back mechanisms maintain the body in "a steady state and tend to produce actions that correct any deviation from this state". Thus "information provided by each of the receptors tends to produce an action by the body that is appropriate to keep our life system stable in the light of the change that the receptor reports". Prof. Young takes the analogy a step further by suggesting that information we convey to other people in our societies is also "an output designed to have some regulating effect".

The second big analogy which he expounds is the likeness of the brain to a giant modern calculating-machine. Such machines 'store' memory, and work with lightning speed. When their kind of mechanism is combined with devices that permit of seeking and avoiding reactions, it is possible to design 'homing' missiles that can decide between correct and incorrect responses. This, it may be supposed, is the way the brain also operates when it compares one thing with another. Prof. Young pursues this analogy and points out that "the major problem is to understand the pattern of activities in the brain by which the input is fitted with the memory, and produces the action". In his account of the learning process he leans heavily on Hebb. He describes how people born blind, who are given their sight by means of surgical intervention, have "to learn to see the world as we do", because "they have no models with which to compare the input, no mould or filter that can be used to select the significant features of visual experience and produce appropriate words and other motor responses". Further, he accepts Hebb's useful thesis that repeated stimulation by any pattern of excitation sets up a closed system of excitation between nerve cells that have become associated during a process of learning, and that as a result a physical trace is ultimately left in the brain.

The final four lectures are more general and discursive. The fifth speculates about the origin of language and of society. The sixth deals with the development of scientific thought, and Prof. Young observes that physics can now be regarded as dealing with the relations between "a man world of observers" and "the reports of what they observe". Consequently, he suggests "a new phase is at hand in which a common science of physics and biology will be necessary". The seventh lecture considers the development of ideas in the biological field. In his concluding talk, Prof. Young discusses the impact of the concept of evolution on that of individuality, elaborating the thesis of the 'continuous' character

of experience, in which the individual is merely a point in a stream of biological time.

It says much for Prof. Young that an effort is needed to remember that his lectures were designed not for an audience of specialists but for a million or more radio-listeners. If it were not for the danger of this confusion, the only task of a reviewer would be to praise an enthusiastic and highly individual piece of popularization, which imparts new design and colour to a subject that has long been a favourite for general writing. It is difficult not to regret, however, that Prof. Young has had to compress so many of his ideas—a shortcoming which he has tried to remedy by adding five short chapters of comments—and also that popularization has sometimes demanded of him excessive simplification and emphasis.

The major pitfall of simplification derives clearly from the stress of analogies. Modern medicine and biological science forged ahead, as Prof. Young reminds us, when, following the example of Descartes and Harvey, increasing use was made of physical models, and when bodily processes began to be analysed and interpreted in terms of mechanism. The value here, following the lines of Prof. Young's thesis, is that the comparison of "something unknown with something already known makes it possible to talk about the unknown". But the danger is that analogies have the habit of either becoming, as Prof. Young warns, a trap for the unwary to believe that they understand fully when they do not, or, what he could have added, mere figures of speech. Prof. Young argues that man's special characteristic is his capacity for communication, and he develops this thesis in relation to the central feature of cybernetic thought, self-regulation, and to Hebb's views of the changes that take place in the brain as learning proceeds. These two ideas become loosely articulated into one major notion—the brain as a giant calculating machine containing fifteen thousand million cells as opposed to the twenty-three thousand valves possessed by the biggest calculating machine so far built. The analogy obviously helps to drive home a possible way of looking at some cerebral functions. And if the analogy between the working of *A* the brain and *B* the machine were complete, in the sense of an exact correspondence, it would, of course, follow that the brain and the machine were no different from each other. But the analogy is not complete, and its emphasis unfortunately obscures three essential differences: first, that the maintenance of a steady state of behaviour is scarcely compatible with an ever-active learning process and an ever-expanding horizon of experience; second, that the sphere of action of the calculating machine is completely predictable, whereas only by an act of faith could we suppose that the same is true of our brains; and third, that the mechanical brain clears itself of all its memory between tasks or runs, whereas the run of a living brain, and its memory, to all intents and purposes last a lifetime. These differences are every bit as vital as any similarities that can be found between artificial and real brains. It begs the question to imply that the reason why the analogy between them is not more complete is, on one hand, ignorance, and, on the other, the immensely greater complexity of the brain relative to the machine. That is where analogies run the danger of becoming mere figures of speech. If, as the reader is told, we do not know much yet about what goes on in our brains, it can only be figurative to suggest at the same time that "it is possible to use our knowledge of brain functioning to understand even the highest activities of man".

Reference to cybernetic and corresponding models does not illuminate the important facts that the process of learning is itself something that is learnt; that every perceiving individual is an active agent who transforms his percepts—and not just a passive receiver of stimuli emanating from a fixed external world; and that the living brain is self-organizing. It is interesting to note that these ideas, to which Prof. Young directs attention, had also been expressed by William James seventy years ago or more—and probably by many others before him—without the help of analogies drawn from modern communication engineering. "Practical utility," wrote James[1], "wholly determines which parts of our sensations we shall be aware of, and which parts we shall ignore. We notice or discriminate an ingredient of sense only so far as we depend upon it to modify our actions. We *comprehend* a thing when we synthesize it by identity with another thing . . . as soon as we have learned how to behave towards it, and how to meet behaviour which we expect from it." Further, in another essay, James spoke of the indomitable desire "to cast the world into a more rational shape in our minds than the shape into which it is thrown there by the crude order of our experience"—and notes that the world has shown itself "plastic to this demand of ours for rationality". Even if his words do sometimes imply the kind of dualism which Prof. Young avoids, William James would probably have therefore held that cybernetics, like "the latest breeze from the physiological horizon" which he scorned, added little to what was known before about processes of thought. The paradox to-day is that cybernetics makes one feel that some new and completely revolutionary idea about the working of the brain is going to spring at us from some hidden corner, whereas the fact is that cybernetic models scarcely help us to understand how the 'output' of the cortex is controlled or how the 'input' fibres are related to the cortical cells, two essential questions which, Prof. Young reminds us, still remain open. Cybernetic ideas will contribute to the solution of these problems only if, like these Reith Lectures, the interest they excite attracts to the experimental study of the brain research workers who, as Prof. Young tells us, are badly wanted at the present time, and whose recruitment would be more than merited by the importance of the subject.

S. Zuckerman

[1] James, William, "The Will to Believe" (New York: Longmans Green and Co., 1923).

MORE NEW SYSTEMATICS

Grundlagen und Methoden einer Erneuerung der Systematik der höheren Pflanzen

Die Forderung dynamischer Systematik im Bereiche der Blütenpflanzen. Von Dr. Franz Buxbaum. Pp. xi+224. (Wien: Springer-Verlag, 1951.) 44*s*. 6*d*.

THERE are many signs of a renewal of interest in botanical (and zoological) taxonomy. The practical importance of reliable and easily workable systems of classification is acknowledged by all who need to know with what organisms they are working and wish so to express the results of their experiments or observations that they can be tested and used. The methods of systematic botany are being greatly improved: nomenclature is (one hopes) being

stabilized, descriptions on the whole are more adequate, types are more carefully chosen and more definitely designated, more and better preserved material is available than formerly, and new data from ecology, genetics and cytology are being incorporated. The development of the ecological and cytogenetical branches of botany is now influencing taxonomic theory, and taxonomists are being forced to consider the basic principles of biological classification. It is not yet possible to foretell what changes, in practice and in theory, will result from the synthesis of old and new; but, with the natural, and defensible, conservatism of taxonomists, they are more likely to come gradually than to take the form of an abrupt revolution. The introduction of new methods and outlooks is being accompanied by an overhaul of those long established. On the whole, taxonomists have every reason to be proud of their products, in spite of criticism from outside their ranks—criticism which is often more connected with the ignorance of the critics than with errors of taxonomists. Well-informed criticism, however, is to be welcomed.

In the present work by Dr. F. Buxbaum there is much that commends itself to both the practical and the philosophical systematist. Unfortunately, the author has apparently had no opportunity to consult more than a very few of the large number of books and papers published in Britain and the United States during the past dozen years or so on the subjects with which he deals. Thus, there is no reference to Huxley's "The New Systematics" or to the various symposia of which accounts have been printed in the *Proceedings of the Linnean Society* and elsewhere. Probably as a result of relative isolation from contemporary arguments on plant taxonomy, the work can scarcely be considered as a full summary of the up-to-date position in the systematics of the higher plants. Nevertheless, the conclusions of a sincere and thoughtful worker must be of considerable value even if one cannot accept all of them. One must agree that the need for better definitions and for making precise and stabilized terminology is felt by many taxonomists. A modern Lindley or Asa Gray would find much to revise. Even so, it may be noted in passing that Dr. Buxbaum on page 43 uses 'rudiment' when from the context he obviously means 'vestige'. Rightly, he says that in place of naming varieties, etc., a clear comprehension of the range of variation of all varying characters should be the aim.

Dr. Buxbaum's concept of plant taxonomy is that it should be 'dynamic', and by this he means that it should be based on 'progressions' or changes in the genom; but in practice, he says, those changes with a morphological expression must be used. Only direct progressions lead to a step-by-step evolutionary advance, while those without direction give especially variability within a species or genus, most often only in the lower categories. A great deal is made of the concept of 'types'. One must regret that this last word is used with such different meanings in biology; and here is intended not the concrete types by which botanical nomenclature is made precise, but the "Summe aller, der betreffenden Kategorie innewohnenden Formgesetze und Entwicklungstendenzen". A 'type' is not an actually existing phenomenon nor is it identical with a progression, but as a rule is the sum total of unequal but more or less equally directed progressions which determine the course of development.

This sounds very nice and is valuable in so far as it directs attention to the fact that the phylogenetic relationships of existing taxa can only be traced backwards in the past. The practical difficulties remain: How can 'progressions' be traced with reasonable certainty in the almost complete absence of relevant fossil evidence in the angiosperms? Cytogenetical researches are throwing some light on probable directions of evolution in a few groups, mostly at or about the species level, but little is said about these in the present work. It is, of course, easy—sometimes far too easy—to arrange series of specimens, whether of organs or of organisms, and to postulate that they represent evolutionary or dynamic progressions. Possibly they may, sometimes; but, as other series can be arranged with the same materials, to call any such phylogenetic is an act of faith. This is not to say either that such series-making has no uses or that phylogenetic speculation is in itself to be condemned. What is needed is more phylogenetic research based on fossils and cytogenetics.

Dr. Buxbaum accepts (p. 71) the usual idea that the lower taxonomic categories in the course of development give rise to the higher. He does not discuss Guppy's reverse view or the possibility of both having some measure of truth. His definition of a 'genus' is worth quoting as it is typical of his point of view: 'Die Gattung ist die Gesamtheit aller Arten, die durch die Einheit ihres morphologischen Typus (Gattungstypus) als stammesgeschichtliche Einheit erkannt wurden" (p. 101). He says that the species concept is a fiction—"die Species keine natürliche Realität ist, d.h. keine unveränderliche und scharf begrenzte Grosse darstellt". Surely, since a genus consists of species, the same conclusion must be reached for this taxon and for other 'higher' taxa also. Dr. Buxbaum has much of value to say regarding the difficulties of applying any concepts of taxa in attempting to make order out of what would otherwise be a chaotic mass of isolated data. He contends that the most important basis of the new phylogenetics is the morphological "Typusforschung": "Der morphologische Typus und seine Entwicklungstendenzen ist das leitende Prinzip der höheren Systematik".

It is obvious that Dr. Buxbaum has been much influenced by the works of Troll on plant morphology. It would be very useful to have a summary of these published in English—particularly of some of the most recent.

That systematic botany is being rejuvenated is evident in many new activities; but its future 'progression' or 'progressions' cannot yet be definitely or fully perceived. In its orthodox form it has well fulfilled a wide range of purposes, theoretical and practical. Possibly for giving latitude and longitude in degrees over the realm of the plant kingdom it will always be of use; but to find position precisely in minutes and seconds a new scheme may be necessary. Taxonomists must certainly take evolutionary concepts more into account. It is becoming increasingly clear, from taxonomic research itself, that, for certain purposes at any rate, we have to abandon the conception of taxa as rigidly definable classes arranged as a hierarchy of species, genera, families, etc., created and maintained as such, whether by the methods of "Paradise Lost", by Linnæus and more recent taxonomists, or by mutation and natural selection. 'Progressions' and 'tendencies' may be vague and difficult to visualize and describe; variations, 'reticulations', and correlations can be dealt with by modern statistical and, to a certain extent, experimental methods. We have as yet no better general scheme of biological classification to replace

that which is now in general use and which is dignified by its long record of service. To seek something better is a sign of future progress; to discard what we have until it be found and tested would be foolish. In so far as Dr. Buxbaum's criticisms of orthodox taxonomic theory and practice and his suggestions for improvements help in the search, they will be widely welcomed by taxonomists. W. B. Turrill

APPLICATIONS AND PRODUCTION OF QUARTZ CRYSTALS

Quartz Vibrators and their Applications

By Dr. P. Vigoureux and C. F. Booth. (Published for the Department of Scientific and Industrial Research.) Pp. xii+371+64 plates. (London: H.M. Stationery Office, 1950.) 30*s*.

THIS book on "Quartz Vibrators" is based on the 1939 edition of "Quartz Oscillators" by P. Vigoureux, but has been made much more comprehensive by revisions and additions of new material on the methods of selecting quartz and producing quartz resonators. Stimulated by the enormous demands for quartz units for frequency stability and for selective purposes which arose during the Second World War, the production of quartz crystals became an important industry. The present book can be considered as a very complete exposition of British practice.

The first few chapters discuss the physical properties of quartz, the occurrence and examination of quartz crystals and give a short exposition of piezoelectric phenomena in crystals. These equations are next applied in deriving the properties of the longitudinal resonator and the thickness resonator. The equivalent electrical circuit for the crystal is used in discussing the stability of a Pierce-type crystal oscillator. The various types of low-coefficient crystals used in oscillators and filters are discussed. The simplest modes of motion and methods for mounting such crystals are described. An excellent chapter discusses the ageing phenomena in quartz crystals and describes methods for getting rid of gross defects. A fine-scale frequency-ageing phenomenon still remains, and it is this effect which produces an ultimate limitation to the accuracy of quartz crystal clocks. The degree of success in producing stable oscillators is discussed, and a day-to-day stability of 1 part in 10^8 is demonstrated. This is ample except for the most exacting primary standards. The use of crystals is described in producing the very selective filters used in the long-distance carrier and coaxial cable systems. A short chapter discusses the use of quartz crystals in underwater sound equipment and in ultrasonics. The remainder of the book is devoted to a very complete discussion of the various methods of sawing, orienting, lapping, etching, plating and mounting quartz crystals.

Several differences between British and American practices may be noted. A number of methods for determining orientation, such as etch pits and cleavage planes as well as X-rays, have been used in British practice, whereas only X-rays have been used in American practice. This latter method has recently been improved by the use of the double-crystal spectrometer, which improves the accuracy with which an angle can be determined. In the field of under-water sound, synthetic crystals such as ammonium dihydrogen phosphate are largely used in American practice in place of the more expensive and less-available quartz crystals.

The book is a very well-written account of the uses of, and manufacturing processes for, quartz crystals. The theories of filters, oscillators and resonators are well presented. The printing is excellent, and many photographs illustrate the manufacturing processes. The book deserves to be purchased by every user and manufacturer of quartz crystals. W. P. Mason

ANÆSTHETICS

The Mode of Action of Anaesthetics

By T. A. B. Harris. Pp. xii+768. (Edinburgh: E. and S. Livingstone, Ltd., 1951.) 42*s*. net.

THIS book gives a most illuminating account of the mode of action of anæsthetics in man. Dr. T. A. B. Harris has gone to great efforts to give a very accurate and up-to-date account of the way different anæsthetic drugs react when administered to a human being, and has written a brilliant synopsis of the observations which have been made by pharmacologists, physiologists, physicists and biochemists of the mode of action of anæsthetics during the past thirty years.

To undertake a task such as Dr. Harris has done in his book is formidable; yet he has succeeded in giving a clear, concise and intelligent account of the action of anæsthetics in man, while at the same time providing an interesting and stimulating synopsis.

Because of the importance stressed by Dr. Harris of a sound knowledge of the action of anæsthetics, and the body's response to them, his book will be a most valuable contribution to the science and practice of anæsthesia. Only by assimilating all that is known about the pharmacology of a drug can it be given wisely and with maximum safety to the patient, and give favourable operative conditions for the surgeon.

Briefly, the text is divided into four parts. The first deals with the action of narcotics, while in the second a full description is given of inhalation and non-volatile anæsthetics. Part 3 is devoted to the correlation of the level of anæsthetic depression of the nervous system with anæsthetic sleep, loss of sensation and loss of muscle movement and muscle tone, with a special reference to the use of *d*-tubocurarine chloride in clinical anæsthesia. The last section discusses metabolism during anæsthesia and the dominant action and side actions of anæsthetics on individual organs and systems, and closes with a chapter about anæsthetic explosions.

Dr. Harris's book is outstanding; hence it is difficult to choose any one section for special commendation. The whole is full of valuable information, is thoroughly reliable, and forms an up-to-date guide to the administration of anæsthetics. It will certainly arouse and stimulate much interest among anæsthetists, and is an ideal book for reference, having an extensive bibliography of two hundred and seven references. To the student of anæsthesia (and all anæsthetists are life-long students) this book will prove of considerable value, since the information it contains should to a large extent help to nullify mistakes. For candidates who have yet to obtain the diploma of anæsthesia, this work should prove of very great assistance for Part 1 and Part 2 of the examination. H. Roy Blades

SCIENCE AND TRIBAL ART

By WILLIAM FAGG

AN exhibition of "Traditional Art from the Colonies", held recently in the Art Gallery of the Imperial Institute, London, was, for the discerning public, an outstanding achievement of the Festival Year, even though it was too modestly advertised; its interest lay not only in the fact that it was the best display of tribal (and especially African) art, selected and arranged as 'art', that has ever been held in Great Britain, but also in the many problems which it offered for solution by scientific disciplines that have no normal connexion with the world of art. I am not now thinking of ethnology and archæology, in which æsthetic studies have, or ought to have, a key place, and which are not sciences in the full sense, but rather of some of the natural sciences, from which important —and perhaps in some cases as yet unsuspected— contributions may be demanded in the next few years.

There is a sense in which all true art—all art, that is to say, which fulfils art's immemorial function of improving upon and 'harmonizing' Nature (in the spirit of the Indo-Aryan root from which both 'art' and 'harmony' are derived)—is, like science itself, inductive. I mean that it proceeds from the particular to the general, beginning from human and other forms and stylizing or generalizing them. It is doubtful whether the *trompe l'œil* schools of art, the photographic realists who aim at nothing more than precise recording of the object, can be called artists at all in any strict sense; some of them, indeed, seek on the contrary to crystallize general ideas in terms of the particular, using purely naturalistic representations to illustrate 'literary' concepts (such as "Love Locked Out") in a manner which we may perhaps term deductive. The method of true art, as of poetry and music, is surely to bring the mind's centres of association into play, and this it does by generalizing things to a point where the spectator is reminded, subconsciously, of other more-or-less related things. Of all kinds of art none demonstrates this aim more clearly than that of the tribal peoples, among whom disciplined stylization is most highly developed; an ancestor figure from Africa may show not a mere portraiture of the deceased individual's features, but rather an abstraction of some of the qualities which are conventionally attributed to the tribal elders, alive or dead; and this quality of generalization is, of course, also found in the finest classical and renaissance art, transcending the naturalism which is their most obvious characteristic.

A further lesson which may be drawn from such an exhibition as the one at the Imperial Institute is that, whereas in the classical tradition of art only one kind of image, a broadly naturalistic one, is permissible, in tribal art no such single canon can be postulated. The possibilities of stylization are clearly unlimited, and in this exhibition there were well over a hundred different styles, in each of which a whole new world of art has been created, internally coherent and completely convincing even to the uncomprehending Western eye; it is meaningless to try to arrange them in order of artistic value or to suppose that there can be an ideal method of stylization.

The greatest problems involved in the scientific study of tribal art are those concerned with its origins and the historical processes by which it is developed (a task in which study of the social milieu of present-day tribal art is by no means irrelevant). The most obvious way in which the natural and physical sciences can be of use is in the dating of excavated pieces, and here geology is naturally most prominent. In the whole field in which African sculpture is found —a field bounded roughly by the Sahara, the Great Lakes and the Kalahari—the oldest art form to which any date has been assigned on reasonably scientific grounds is the terra-cotta sculpture of which traces have been coming to light during the past eight years around the village of Nok, south of the Central Plateau of Nigeria; the few examples in the exhibition were enough to show that sculpture was in a highly developed state in Northern Nigeria many centuries ago. The pottery figurines, most of them fragmentary, are generally found at a depth of about 25 ft. in alluvial tin-bearing deposits which geologists have recently dated provisionally to the second half of the first millennium B.C. Geological dating is still very difficult in West Africa, whereas in North, East and South Africa elaborate successions have been drawn up with fairly general agreement and are being constantly refined. The dating of the Nok culture is based on a correlation of the deposits in which it is found with the Nakuru Wet Phase of East Africa; but much further pure research in West African geology is needed before the theory can be considered established, and it must also be noted that even a fully successful correlation of East and West African deposits in a geological sense would not necessarily establish synchronism. There is a good prospect that archæology will prove as helpful to geology as geology to archæology.

The great majority of the exhibited sculptures were in wood, and we may note the possibility that dendrochronology, developed with such success in the south-western part of the United States, may be found to work in West Africa also; but little or no study of the formation of tree rings seems to have been carried out there as yet. Simple identifications of the woods used by carvers may, however, be of great value in technological study and also, no doubt, in the identification of styles. It may be worth mentioning that an effort is to be made to test the application of the radiocarbon method of dating to fossil trees found in the Nok deposits with the terra-cotta sculptures.

Metallurgy and chemistry are of particular importance in West African studies because of our dependence on bronze castings for most of our knowledge of art traditions older than about a hundred years (a life span seldom exceeded by wood carvings). The exhibition at the Imperial Institute included some of the most important pieces of bronze and brass work from the Guinea coast, including several of the famous bronze heads from Ife (flown from Nigeria) and representatives of all periods of the related work of Benin, beginning almost certainly before the first arrival of the Portuguese. Already it appears probable that brass (copper alloyed with lead or zinc or both) or virtually pure copper was normally used until the Portuguese introduced the true tin bronze. The

opportunity afforded by the brief presence in Britain of these Nigerian treasures has been taken to carry out further scientific research upon them in the research laboratory of the British Museum.

It is now accepted that science has a great part to play in the critical study and treatment of European art; one may instance Dr. H. J. Plenderleith's part in the detection of the van Meegeren forgeries of Vermeer, or the elaborate techniques used in the cleaning of old paintings. Tribal art demands comparable methods: difficulties are involved in the cleaning and preservation of such things as ancient bronzes of superb patination or recent wood-carvings painted in earth colours or infested with woodworm; and forgeries are far from uncommon in the European market (though they are fast being lost to the United States). Science has yet to say the final word on the authenticity of what is probably the most famous of all West African bronzes, the "Olokun" head of Ife in Yorubaland; the results of a preliminary critical examination were given in *Man* of January 1949, and it is hoped that it may soon be sent to England again for a further period of study; meanwhile, it appears to be a skilful replica of the head seen by Frobenius in 1910.

There is, however, one form of scientific investigation—involving biology and applied mathematics—which, so far as I know, has never yet been attempted in the field of tribal art, or probably in any artistic field at all, and one can only briefly mention it in this article. It is concerned with what I may call the mathematical basis of distortion in the interests of art, and for that reason tribal art is clearly the most promising field, and classical art, in which distortion of natural forms is practically excluded, the least promising. There is, indeed, one minor form of European art—caricature—in which distortion and exaggeration play almost as characteristic a part as they do in tribal art; and in the best caricature it would doubtless be found that the exaggerations of a given physiognomy bear a definite and coherent (though not an absolutely precise) mathematical relation to its natural proportions—for example, a politician with a prominent forehead and chin and a somewhat 'dished' profile might find these features carried by the caricaturist's pen to lengths impossible in Nature, and yet, because the relation between the parts remains the same, the distortions render him more rather than less recognizable by the general public. It is possible to express this phenomenon mathematically by means of a series of exponentially curved co-ordinates similar to those employed by Mr. R. Guley Lewis in an article on "Co-ordinates as a Clue to the Morphology of Human Profiles" in *Man* of April 1949 (though that article had no reference to art). The same principles could be profitably applied to much tribal sculpture, in which exponential curves may be found directly represented, besides being followed, unconsciously, in the distortion of other forms. It might be found that the carvers who conformed most closely to D'Arcy Thompson's principles of growth and form were also those recognized as the greatest masters both by their own people and by European critics, and in that case a great step forward in objective criticism would have been taken. I looked forward to some guidance in this connexion when the Institute of Contemporary Arts recently held an exhibition entitled "Growth and Form" and inspired by D'Arcy Thompson's book; but I was disappointed to find that little serious effort had been made to relate his work to the world of art, though it is certainly of great interest that it should be brought to the attention of artists at all. Yet anyone with a scientific as well as an artistic bent who went on from that exhibition to the display of tribal art at the Imperial Institute might well find many a bell rung in his mind by their exotic forms and volumes.

A PHILOSOPHY OF NUTRITION

By Dr. FRANCIS AYLWARD*

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ON many occasions in recent years attention has been directed to the increasing food requirements of the world following the rapid and continuing growth in population and the desire in all countries for a higher standard of living. The dangers arising from soil erosion have also been stressed, leading as it does to a substantial decline in food production. Several writers have presented a dismal picture of progressive starvation in some regions of the world. Others have adopted a less pessimistic point of view and have suggested that the way to safety lies in an active programme for the efficient conservation and the fuller utilization of the natural resources of the world, together with the development of sparsely populated countries.

In relation to this last point, a question of great importance is whether or not there are sources of foods indigenous to certain countries but perhaps little known in Western Europe or on the North American continent. This is a problem which for the past eight years has been the subject of investigations by Dr. R. H. Harris and his colleagues at the Massachusetts Institute of Technology, who set themselves the task of analysing the foods grown and eaten in Mexico and other countries of Central America. The research programme involved: (i) the collection and analysis of a large number of edible plants; (ii) the examination of methods of food preparation and the determination of the composition of prepared foods; (iii) a survey of dietary habits; and (iv) a clinical and biochemical investigation of nutritional status.

The work of the Massachusetts group has been characterized by its thoroughness and by the range of analyses carried out over a very wide area; it has already had far-reaching consequences and has led to a new outlook on nutritional problems in the countries concerned. In Mexico City, laboratories have been established at the National Institute of Nutrition for the development of a food analysis programme to be integrated with clinical surveys. Even more striking is the foundation of an Institute of Nutrition of Central America and Panama, an experiment in international co-operation of prime importance in that the central laboratories opened in Guatemala City in 1949 will serve all the countries of the region.

The purpose of the present review is to outline some of the findings of the American group and to relate them to results of investigations in Africa and Asia.

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Composition of Indigenous Foods

Mexico and Central America[1]. The collection of food plants in Mexico and Central America was carried out by a botanist, experienced in taxonomy, who obtained more than a thousand samples distributed as follows: Mexico 393; Honduras 200; Guatemala 230; El Salvador 273; Nicaragua 51; Panama 4; Costa Rica 154.

Often several samples of the same species of a plant were collected from different regions in a country, and in the area as a whole there was further duplication which enabled information to be obtained regarding the variations which can occur in the composition of any one plant under different soil and climatic conditions.

One specimen of each plant was placed aside for detailed botanical identification, and full records were made regarding its use as a food. Samples of the edible parts of a second specimen were macerated, treated with suitable preservatives and dispatched by air to the Massachusetts laboratories, where analyses were carried out for moisture, crude fibre, ether extract, nitrogen, phosphorus, calcium, iron, ascorbic acid, thiamine, riboflavin, niacin and vitamin A (as carotene). Control experiments established that no significant quantities of even the most unstable nutrient (ascorbic acid) were lost in the intervals between sampling and analysis.

Many of the plants examined, including species and varieties unknown as food sources in the United States and not previously analysed, were found to contain high levels of certain nutrients (see Table 1). Moreover, varieties of some plants were higher in nutritive value than corresponding varieties grown in the United States. Thus the standard tables of food composition based on plants grown in temperate zones cannot necessarily be used for the calculation of tropical and semi-tropical diets without the possibility of significant errors.

The survey of the composition of crops was extended to include studies of prepared foods and, although these are by no means complete, information of value has already been obtained. Harris[2] has examined the *tortilla*, the 'daily bread' of Mexico which is prepared from Indian corn (maize) by a relatively complicated process. The maize is soaked in a 1 per cent lime suspension and is heated to 80° for twenty to forty-five minutes, after which the mixture is allowed to stand until the following day. The liquid is then decanted off, the maize is washed two or three times with water, the resulting *nixtamal* is finally ground in a mill and the pulverized *masa*, in units of about 50 gm., is shaped into thin cakes and cooked on an iron plate. The original maize and the intermediate and final products were analysed (see Table 2), and it was found that the calcium content of the *tortilla* had increased twenty-fold compared with the original maize, because of the lime treatment.

TABLE 1. COMPARISON OF NUTRITIVE VALUE OF FOOD PLANTS IN CENTRAL AMERICA AND THE UNITED STATES

	Minimum value as basis of comparison (mgm./100 gm.)	No. of food plants above minimum value		No. of Central American food plants above U.S. maximum
		United States	Central America	
Nitrogen	2,500·0	8	20	1
Calcium	100·0	12	39	6
Iron	3·0	19	51	10
Carotene	2·0	14	32	3
Thiamine	0·2	16	42	5
Riboflavin	0·2	13	34	1
Niacin	2·0	13	31	0
Ascorbic acid	75·0	7	48	20

TABLE 2. ANALYSES OF *Tortilla*
Mean values (mgm./100 gm. dry weight)

	Maize	*Nixtamal*	*Tortilla*
Calcium	9	169	190
Phosphorus	275	294	317
Iron	2·7	3·3	3·7
Carotene	0·18	0·15	0·10
Thiamine	0·39	0·35	0·33
Riboflavin	0·09	0·10	0·10
Niacin	1·90	1·80	1·67

The average daily consumption of *tortilla* is of the order of 280 gm. but may be as high as 700 gm., and it is therefore an important source of both calories and minerals, and is a by no means negligible source of some vitamins. Thus these studies provide an interesting demonstration of the importance of local custom and show how false conclusions may be drawn from surveys which do not include methods of food preparation. Another item in the diet of the Mexican Indian is a fermented drink, *pulque*, obtained from a cactus; it provides various minerals and vitamins—especially ascorbic acid. Its use was at one time prohibited; but the resulting illnesses necessitated the removal of the ban[3].

Africa, Asia and Australasia. The activities of the Massachusetts group were extended to China at a stage in the Second World War when it seemed likely that American troops would be stationed there and would require food grown on Chinese soil. Harris[4] was able to demonstrate the high nutritive value of many plants and food preparations analysed.

There is a miscellaneous and not always readily available literature on gardening methods and on plants indigenous to Asia and Africa, and in some cases analyses have been carried out. Yet until recently there was not, perhaps, a sufficient appreciation of the wide variations likely to be found in crops grown in different regions; on the whole, there was a tendency to accept standard Western analyses, and furthermore to regard indigenous foods as of secondary importance.

There were notable exceptions to this attitude, as may be seen from the review of Gangulee[5] and from the work of Aykroyd[6] and his colleagues in India, of Rosedale[7] in Malaya and of Platt[8] in Nyasaland. Abundant evidence of the newer outlook was revealed at the conference of the Nutrition Society on Colonial Problems[9] in March 1946; but at that conference Platt expressed the opinion that the information available on native foods "is approximate and is reasonably satisfactory only for territories largely dependent on imported foods or for those which have more highly developed economies or well-staffed departments of agriculture". On the same occasion, Firth stated how surprised he had been to discover in 1939 that in spite of the excellent surveys in Singapore—extending to 1,000 families—most of these studies were urban; "very little work had been done among the peasants" and "there was not a single full-scale nutritional study in a rural area in Malaya".

Testimony in favour of the importance of native foods has been provided by medical officers who were in prisoner-of-war camps in Asia. Reed has contended that "there is much to be learnt about

edible plants which grow easily and the unusual foods which effectively helped to save our lives", and Allen and Scott MacGregor[10] have endorsed this point of view. Stannus[9], from his experience in Africa, has affirmed, "it is not enough to deal only with the main staples and one or two other constituents in the diet. Results are likely to be erroneous unless investigators have an intimate acquaintance with the native and his daily life. Account must be taken of the occasional snack of dried oily fish . . . the fried grasshopper, the raw sugar cane, the assortment of green leaves which the women know so well how to select and cook and, last but not least, the mug of native beer."

During the post-war years, Platt[8] and other members of the staff of the Human Nutritional Unit of the Medical Research Council have stressed the importance of dietary surveys and have published analyses of tropical foods. Parallel action has been taken by Australian workers[11] in New Guinea, and the newer information has been reviewed by Nichols[12]

Nutritional Surveys

The studies of food composition carried out by Harris have been correlated with investigations of the nutritional status of children and adults in Mexico City and elsewhere. One team of workers who had previously conducted surveys in the United States reported that a group of 1,000 poverty-stricken Mexican children showed evidence of a nutritional status superior to that of a group of 760 middle-class children in Michigan, and this surprising conclusion was confirmed by other investigators who examined different age groups in both urban and rural communities. In all cases the incidence of detectable malnutrition was low, although the diets included few, if any, of the ordinary foods common in Europe and the United States[3].

Harris and his colleagues do not suggest that no improvements are necessary; they believe that the people are living on diets which are fairly well balanced in respect to proteins, minerals and vitamins, although the actual amount of food available may be inadequate. 'Balanced starvation' does not necessarily result in the typical histological and biochemical changes indicative of malnutrition; the effects of what has been described as 'hollow hunger' may be seen in the mental outlook of a people, and notably in a disinclination to make physical effort.

The American workers have presented a more optimistic picture of the nutritional state of the people of Mexico than might have been expected; so, too, warnings against excessive pessimism have been given by Stannus[9], who has pointed out that from the bare figures of a nutritional survey in Africa, the whole population in some regions might be expected to be suffering from malnutrition, although observations reveal that this is not so. Cathcart[13] has also suggested the need for a cautious interpretation of the results of surveys, affirming that "any diet can be regarded as defective if you put your standards high enough".

Food and Population

The surveys of diets and nutritional status, taken in conjunction with the laboratory findings of food composition, point to the conclusion that many countries should be able to raise nutritional standards and to promote a positive health policy, on the basis of improvements in agriculture leading to a greater production of certain crops of special value. Harris believes that it is necessary to recognize the importance of dietary patterns which vary from one country to another, and indeed from one area to another in the same country. These patterns are the results of age-old experience and accumulated wisdom, and any drastic and sudden change may lead to widespread malnutrition. Modifications have taken place and perhaps should take place, but any recommendations for changes should be made only with the full knowledge of both the immediate effects and later consequences.

For long periods of time communities have existed and have increased and multiplied without our newer knowledge of nutrition, and dependent almost entirely on indigenous crops and to a lesser extent on animals. The indigenous foods of many areas, when judged by the tests of history and also of vital statistics, must contain within themselves the nutrients essential for growth and reproduction. There may be specific deficiencies in some areas; there may be food shortages because of over-population or crop failure; there may be problems following industrialization and the growth of large towns, but rural communities are usually able to thrive.

It is evident that a distinction must be made between basic nutritional concepts which have universal significance and secondary concepts, such as the primacy of animal proteins and the necessity of milk and orange juice which may not have world-wide application. Certain dietary programmes which may be ideal in Western Europe or in North America may be unsuitable or impossible in other regions. Thus as part of any campaign for improved agriculture in under-developed countries, there must be a plan of education in which the theory of nutrition is taught and also its practice, with the proviso that diets recommended should be based as far as possible on the existing habits of the people rather than chosen from a typical European or American diet sheet.

Much remains to be done in Central America and elsewhere to correlate clinical and laboratory investigations. The establishment of minimum dietary standards for minerals and vitamins in terms of indigenous crops is but one aspect of the programme. Further and more difficult tasks are the determination of the biological values of the proteins available in these crops and the assessment of the relative quantities of fats, carbohydrates and proteins that can be obtained from the sources available and included in a diet of adequate calorie content. Clearly the implementation of a programme on the above lines will involve extensive laboratory work on crops and food products in many regions, and this must be carried out using standard methods and techniques so that the results obtained in different centres may be comparable.

It is good to know that groups of workers, one concerned with the 'good neighbours' south of the United States' border, others concerned with the Asiatic Dominions and the African territories, have by different routes come to somewhat similar conclusions in the recognition of indigenous dietary patterns and of indigenous agriculture as a basis of sound nutrition. When the existing facts are more generally known, if the results are extended and confirmed, if there is a more adequate recognition of the value of mixed proteins from plants, then there

may be some recession in that pessimism which has become so common in the consideration of the world's food supply.

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OBITUARIES

Prof. C. J. van der Horst

PROF. C. J. VAN DER HORST died in Johannesburg on Oct. 10. He was born in Holland on May 11, 1889, and educated in that country, studying under Profs. Hugo de Vries and Max Weber in the University of Amsterdam. His thesis for the doctorate was on the structure of the brain in fish. On graduation he was appointed chief assistant to Prof. Sluiter in Amsterdam, and there wrote a monograph on the corals of the *Siboga* expedition. He soon returned to neurology, working with Judson Herrick in Chicago, and becoming sub-director of the Institute for Brain Research (Herseninstitut) in Amsterdam in 1925 under its director, the late Prof. C. U. Ariëns Kappers. Van der Horst was thus a zoologist of unusually wide interests and knowledge when he was appointed senior lecturer in zoology in Johannesburg in 1928 under the late Prof. H. B. Fantham. There he soon established a reputation as a man of scientific distinction, of sound judgment, and of great personal charm. Thus it was natural that he should succeed to the chair of zoology in 1932, when Prof. Fantham accepted the chair of zoology in McGill University, Montreal.

In the meantime, van der Horst had turned his attention to the Enteropneusta, soon becoming recognized as the authority on those animals. His review of the group in Bronn's "Tierreich" is an original and lasting contribution to systematic zoology.

Then, at a relatively mature age, following the example of his illustrious fellow-countryman, A. A. W. Hubrecht, van der Horst turned to the study of mammalian embryology and began to collect developmental material of many of the rarer and more interesting South African mammals, gradually building up magnificent collections of the elephant shrew (*Elephantulus*), the golden mole (*Eremitalpa*), *Pedetes* and other forms. The first fruits of this work appeared in a series of papers (1940–46) in collaboration with Dr. J. Gillman, in which the authors elucidated the reproductive cycle of *Elephantulus*, providing detailed descriptions of the ovarian and uterine changes and valuable discussions of the mechanism of ovulation and the history and functional significance of the corpus luteum. They showed that *Elephantulus* far surpasses all other mammals in the number of ova shed at each ovulation (up to 120 or more), and that out of this large number only two eggs become implanted and survive (one in each uterus). In two outstanding papers on the early development of *Elephantulus* (1942, 1943) van der Horst showed that it displays features of very great interest, some of them, indeed, unique; for example, the attainment of a vesicular blastula already in the four-celled stage and the formation of the embryonal knot from amœboid cells detached from the blastocyst wall. In later papers, he described for the first time early stages in the development of the golden mole and the first phases of placental development in the aardvark (*Orycteropus*); and in a highly important paper (1949) he showed that the placenta of the tree-shrew (*Tupaia*) is not haemo-chorial, as Hubrecht believed, but belongs to the more primitive endothelio-chorial type, a discovery of significance in view of the discussions as to the systematic position of the tree-shrews. His last contribution (1950) provides a detailed account of the placentation of *Elephantulus*, together with an interesting discussion of the relevant literature. The contributions he has made to mammalian embryology show how very greatly we must regret that his work in this field has come to so untimely an end.

Prof. van der Horst's influence on the development of zoology in South Africa has been great; the courses given in his department have presented the subject as a whole, extending far beyond the comparative anatomy which was his own field. Thus, impressed with the impossibility of teaching students who had no access to the sea, van der Horst found an island off Lorenço Marques to which he took students, living in camp and working in a temporary hut. This course proved so successful that a year ago the Portuguese Government built a permanent marine station on the island for the use of the University of Johannesburg, in effect as a tribute to van der Horst himself, an account of which by Mrs. Tattersall will be found in *Nature* of December 1, p. 946. It is to be hoped that the station will be permanently associated with his name.

Prof. van der Horst was one of the kindliest and most generous of men, and his unexpected death will be felt with a deep sense of loss not only by his colleagues in South Africa but also by his many friends in Great Britain and other European countries. He was elected a corresponding member of the Zoological Society of London in 1943, and in 1950 was awarded the Linnean Gold Medal of the Swedish Academy of Science, an honour he greatly appreciated. He was a member of the International Institute of Embryology (1948) and a Foreign Member of the Royal Netherlands Academy (1950) and of the Norwegian Academy of Science (1951). His wife and daughter survive him, and to them we offer our sympathy.

Mr. F. O. Barlow

FRANK OSWELL BARLOW, well known for his casts and restorations of fossil human skulls, died at Merston, Sussex, on November 12. In August 1896, when fifteen years old, he entered the Geological Department of the British Museum (Natural History) as an unpaid learner in the workshop. In 1908 he there succeeded his father as "mason" (as the chief preparator was then called). Caleb Barlow had been in the Museum since 1874, developing, modelling, casting and mounting fossils, mainly vertebrates

His son carried on the same kind of work with great distinction for forty-five years, until he retired in 1941.

During 1903–4 Mr. Barlow spent a year in the Fayum (Egypt) excavating Cænozoic vertebrates with Dr. C. W. Andrews, and afterwards made restorations of the most important finds, such as *Arsinoitherium*. He developed Sir Arthur Smith Woodward's collection of Pliocene mammal remains from Pikermi, Greece, and many other famous specimens, including *Archæopteryx*. His last major work at the Museum was to carry out the difficult task of restoring the head of the Triassic amphibian *Cyclotosaurus* from mere cavities in the rock.

To the outside world, he was best known for his work in palæoanthropology, and particularly for his modelling of Smith Woodward's restoration of the Piltdown skull. He is one of the figures seen standing behind Sir Arthur Keith in the painting by John Cooke, R.A., illustrating the Piltdown controversy (1913), which now hangs in the rooms of the Geological Society of London. He was not placed on the pensionable staff of the Museum until 1921, and, like his father, he had worked in his spare time with the firm of R. F. Damon and Co., which he eventually took over, and developed on the anthropological side. For many years he provided scientific institutions all over the world with casts of the chief specimens of fossil men, produced with unparalleled skill and fidelity. His stock of moulds has now been taken over by the Wenner-Gren Foundation in order that his work may be continued.

Mr. Barlow will be remembered by all who knew him for his personality, his massively imposing figure, resonant voice and courteous approach. He was a man of wide culture, as his conversation revealed. He had an extensive knowledge of literature and, like his father, he was musical. His rich bass voice was for many years heard in male voice choirs, and he sang at coronations and other special occasions in Westminster Abbey. He spent his last decade in the pleasant half-timbered Old Parsonage at Merston near Chichester.

W. N. Edwards

NEWS and VIEWS

Queen's University of Belfast

At the Queen's University of Belfast three appointments to chairs have recently been made as follows.

Agricultural Botany: Dr. P. A. Linehan

The whole of Dr. P. A. Linehan's working career has been with the Department of Agricultural Botany in Queen's University and with the Botany Division of the Ministry of Agriculture, Northern Ireland; he has held simultaneous appointments in these two bodies, the most recent being reader and head of the Division, respectively. Dr. Linehan was part-time chairman at the Ninth International Seed Testing Congress, held in Washington, D.C., in 1950, and is a member of various technical committees on seed-testing. He was a foundation member, has been honorary treasurer, and is at present a member of the executive committee and editorial board of the British Grassland Society.

Comparative Pathology: Dr. H. G. Lamont, O.B.E.

After being engaged for a number of years in veterinary and pathological research, Dr. H. G. Lamont was appointed in 1931 to be head of both the Veterinary Research and Dairy Bacteriological Divisions of the Ministry of Agriculture, Northern Ireland; at the same time he was made a lecturer in both veterinary science and dairy bacteriology in Queen's University, and in 1947 was promoted to be reader in veterinary science. In 1941 he was awarded the D.Sc. degree of the University for a thesis on "Observations on Aujeszky's Diseases in Northern Ireland", a neurotrophic virus disease of domestic animals. Dr. Lamont is a member of the Agricultural Research Council committee on pig disease, tuberculosis and tuberculin, and mastitis. He was created an O.B.E. in 1950.

Pure Mathematics: Dr. S. Verblunsky

Dr. Samuel Verblunsky goes to the chair of pure mathematics in Queen's University in place of Prof. T. G. Room, who was unable to take up the appointment (see *Nature*, April 21, p. 630). Dr. Verblunsky was born in London and was educated at Magdalene College, Cambridge, where in 1927 he was a Wrangler with distinction in schedule *B*, later becoming a Rayleigh prizeman and Allen scholar of the University. He was for nine years a lecturer at the Manchester College of Technology and then was appointed to a lectureship at Queen's University, being promoted reader in 1950. He is author of a book on "An Introduction to the Theory of Functions of a Real Variable".

Pittsburgh Award of the Pittsburgh Section, American Chemical Society: Dr. W. A. Gruse

The Pittsburgh Section of the American Chemical Society has announced that the Pittsburgh Award for outstanding service to chemistry has been made to Dr. W. A. Gruse, administrative fellow of the Petroleum Refining Fellowship at the Mellon Institute, Pittsburgh. The Award is in recognition of Dr. Gruse's activities as a technical administrator and acknowledged expert in the field of petroleum chemistry, and more particularly for the work of his Fellowship, financed by the Gulf Research and Development Co., which has resulted in fundamental improvements in the refining of petrol, lubricating oil, waxes and other petroleum products. After graduating at Johns Hopkins University and taking his Ph.D. at the University of Wisconsin, Dr. Gruse taught for some years, and then served in the Chemical Warfare Service during the First World War. He became a fellow of the Mellon Institute in 1919 and a senior fellow in 1923, and then in 1945 took up his present appointment at the Institute. During the Second World War he was awarded a Certificate of Merit from the United States Office of Scientific Research and Development, and the Distinguished Service Award of the Ordnance Department. Dr. Gruse has been very active in the American Chemical Society, having been first secretary of the Petroleum Division in 1921, and chairman of the Pittsburgh Section during 1943–44; he is chairman of the Committee on Automotive Engine Oils of the American Society for Testing Materials.

Part-time Work in Chemical Engineering

The would-be chemical engineer is in the unfortunate position of having to acquire a knowledge of the fundamental principles of both chemistry and engineering before he can embark on the application

of these principles to the design of plant and the development of processes. This preliminary work cannot be greatly curtailed, and consequently the training of a chemical engineer is bound to take longer than that of a pure chemist or an engineer. The Institution of Chemical Engineers published some years ago a scheme for a full-time degree course in chemical engineering extending over four years; but, in view of the great shortage of chemical engineers, it has been felt for some time that degree courses alone are not sufficient and that a valuable method of increasing the supply of chemical engineers would be the establishment of part-time courses. The difficulty has been to devise such courses without making them of inordinate length. The Institution has now put forward a method of instruction in the form of a pamphlet entitled "Scheme for a Part-time Course in Chemical Engineering" (pp. 23; London: the Institution, 1951; 2*s*.). This is described, perhaps optimistically, as a three-year course with an "endorsement year" for entrants already holding Ordinary National Certificates in chemistry or mechanical engineering. It is quite clear, however, that the course is really one of four years, as, without the endorsement year, it would be very incomplete; with the endorsement year, the course is admirable and, on paper at least, equivalent to the degree course. Detailed syllabuses and the approximate times spent on each subject are given, which, though only suggestions, will undoubtedly prove of great value to those who are considering the possibilities of such a course. It should be noted that the times given include laboratory work. In addition to the purely formal matter, the pamphlet abounds in brief remarks on the underlying principles of the teaching and the emphasis to be placed on different subjects; it is worth reading for these alone.

Weather Artistry

THREE recent articles by L. C. W. Bonacina in the Royal Meteorological Society's monthly periodical *Weather* deal with the picturesque effects of weather, especially cloudscapes. The first, "The Scenery of Devonshire in Relation to Weather and Climate" (May 1951), is a rapid tour through the coastlands, valleys and moors in sunshine, shower, frost, fog and snow. In "London's Picturesque Cloud Scenery" (November 1951) we read how, in the built-up areas of south-east England, man may play havoc with the beauties of hill and woodland, but the sky is fortunately beyond his reach. Even the pearly London smoke-haze may add to the beauty of "faltering glints of silvery or golden sunlight seen to perfection as they steal across the Thames". London fogs are rather tactfully passed over. The remaining article, "Turner as a Weather Painter, a Centenary Appreciation" (July 1951), which is illustrated by reproductions of "The Wreck" and "Snowstorm", is a skilful analysis of the weather symbolism in Turner's renderings of cloud and sea, and the effects of sunshine and haze on vistas of mountains. In fact, as Mr. Bonacina points out, instantaneous detail of actual weather in paint is almost impossible for an artist to realize; he can only reproduce the spirit of the rapidly changing scene. Turner's cloudscapes may not be perfect meteorology, but they are magnificent art.

Processing Colonial Raw Materials

IN a Colonial Office publication, "The Processing of Colonial Raw Materials", by Charlotte Leubuscher (pp. 186; London: H.M.S.O., 1951; 10*s*. net), it is pointed out that the root causes why processing industries have not developed in many tropical countries are general economic backwardness and low standards of living. Prospects for the establishment of processing industries are brightest for materials such as oilseeds and cane sugar, which have a local market or where such a market might easily be established. There is less likelihood that processing factories can be successfully established for materials such as cocoa or sisal for which the markets are almost entirely outside the producing countries. Often a producing territory provides too small a basis for the development of an efficient industry. The market in this event would have to be regional, but it does not follow that the most advantageous situation for a processing industry will necessarily be in the country producing the bulk of the raw material. In other words, it is likely that the tendency for industries to be attracted by the markets where their output is sold will assert itself also in the tropics. This is exemplified by the comparatively advanced industrial development of Trinidad within the West Indian region and the industrial importance of Singapore where raw materials from the Malayan hinterland and Indonesia are processed on a large scale.

Soil Survey of Great Britain: Report for 1950

THE Soil Survey Research Board of the Agricultural Research Council has recently published report No. 3 of the Soil Survey of Great Britain (pp. 36+3 plates; London: H.M.S.O., 1951; 3*s*. net). This report summarizes the progress made during 1950 and gives brief descriptions of new series found. It also includes an obituary of Prof. G. W. Robinson, chairman of the Board, who died during the year. The broad classification of previous reports has been retained; this follows current international practice, with subdivisions to take into account differences in drainage and in the rocks from which the soils are formed. The classification is shown by tables, and this should assist in the recognition of soils developed on the same rocks in those parts of Britain which have not yet been mapped. During the year a further 327,000 acres have been surveyed, and work has continued in Lancashire, Yorkshire, Banffshire, Kincardineshire and Angus, Roxburghshire and Ayrshire. The survey of a sheet around Cambridge has been started with the view of obtaining information about the Fenland soils. The sheets covering Anglesey and the Glastonbury (Somerset) sheet have been completed and are being prepared for publication, and the Wem (Shropshire) sheet is in an advanced state of preparation for publication. Soil maps and reports of the north of Banffshire and the north-east of Aberdeenshire are almost ready for printing.

Science Abstracting: Final Report of the Paris International Conference

THE final report of the International Conference on Science Abstracting, convened in Paris by the United Nations Educational, Scientific and Cultural Organization during June 20–25, 1949, has now been issued (pp. 192+10 plates. Paris: Unesco; London: H.M.S.O., 1951; 12*s*. 3*d*. net) and gives a clear idea of studies and discussions out of which the recommendations of the Final Act of the Conference (see *Nature*, 164, 998; 1949) emerged; the Final Act is given in the appendixes to the report. These appendixes also include, among other documents, the

declaration on fair dealing in regard to copying from scientific periodicals and the guide for the preparation of synopses, issued by the Royal Society in April 1949, and the recommendations and resolutions adopted in June 1949 by the Interim Co-ordinating Committee on Medical and Biological Abstracting, as well as a bibliography. The ten chapters of the report review briefly the preliminary report and its preparation; types of abstract and the scope and nature of abstracting services; the authorship of abstracts; methods of publication, including costs, arrangement and the desirability of common bibliographical rules; methods of distribution, including the use of offprints and microfilms and means of reducing the time-lag; the selection of abstracts, including indexing systems and the classifications on which indexing systems are based, and the mechanical selection of documents; language problems and the value of translations; the distribution of articles and abstracts by subject; the co-ordination of abstracting services; and the future organization of science abstracting. The report is thus a useful commentary on the Final Act, indicating the trend of responsible opinion on the question, not merely of abstracting but also of the dissemination of science information in the scientific and technical world generally. It is a reference work which should facilitate understanding of, and co-operation in, a difficult field.

Determination of Earthquake Azimuths from Observations at a Single Station

Prof. W. Hiller, of Stuttgart, in a paper entitled "Uber die Bestimmung des Azimuts von Fernbeben aus Oberflächenwellen" (*Gerlands Beiträge zur Geophysik*, **61**, Heft 4, 221–231, Leipzig; 1950), has published details of a method of finding the azimuth of an earthquake from observations at one station. Prof. Hiller states that in many earthquakes the *P* waves are only feebly recorded, or indeed may not be recorded at all, so that the determination of azimuth by means of *P* waves is not possible in these cases. In most earthquakes the surface waves are strongly registered. If one has at one's disposal a record of an earthquake on each of three components obtained with instruments having as nearly as possible the same constants, it is possible to find those positions in the surface waves which indicate the arrival at the observatory of pure Love waves or pure Rayleigh waves. The direction of oscillation of the Rayleigh waves is then used to give the azimuth of the epicentre. (In a Rayleigh wave the motion of the earth particle is in the form of an ellipse in the plane containing the vertical and the direction of the earthquake epicentre to the observatory. The motion of the particle in the ellipse is towards the epicentre at the top of the ellipse.) Prof. Hiller has applied this method with success to hundreds of cases in which the seismograms from the Stuttgart Galitzin–Wilip instruments were used; and illustrated examples are given in the paper.

Bibliography of Seismology

Nos. 6, 7 and 8 of Vol. 14 of the Bibliography of Seismology, published by the Dominion Observatory, Ottawa (Ottawa: King's Printer), contain 438 items of pure and applied seismology. The intense interest in microseisms appears to have passed its peak in 1948–49, since in Nos. 5 and 6 of the Bibliography no fewer than twenty-eight items referred to microseisms, whereas in Nos. 7 and 8 nineteen items were so listed. The mathematical aspects of seismic waves still attract attention, and it appears that a renewed interest in seismographs exists; in Nos. 5 and 6 of the Bibliography nine items were concerned with instruments, whereas in Nos. 7 and 8 twenty items referred to seismographs. There is no doubt that a need is now felt for several instruments designed to work in prescribed conditions and to record particular seismic phenomena, as distinct from one instrument designed to record as many seismic waves as possible. Item 7,407 in the Bibliography refers to one of the latest problems in earthquake waves, namely, "The *T* Phase of Shallow Focus Earthquakes", by Ivan Tolstoy and Maurice Ewing (*Bull. Seis. Soc. America*, **40**, No. 1; January 1950). This *T* phase appears to be a feature of submarine earthquakes and may be of use in giving a warning of tsunamis. Recent theoretical work mentioned (Item 7,200) is "On the Nature of the Earth's Interior" by W. H. Ramsey (*Mon. Not. Roy. Astro. Soc., Geophys. Supp.*, **5**, No. 9; October 1949) and refers to work on the calculated effects of pressure on the atomic constitution of materials within the earth. In this connexion reference may also be made to Dr. Ramsey's article in *Nature* of October 20, p. 676.

Apia Observatory, Western Samoa: Report for 1941

The annual report for 1941 of the Apia Observatory, Western Samoa (pp. 170; Wellington, New Zealand: Government Printer, 1950) has only recently been issued. Observations during that year were made in the following geophysical subjects: terrestrial magnetism, seismology, meteorology, atmospheric electricity and tides; details are given in tabular matter or otherwise. Preliminary remarks at the beginning of the various sections describe the instruments and provide other relevant information. Hourly scalings of heights of the tides, automatic recording being made by means of the portable tide-gauge No. 11664, together with times and heights of high and low water, were sent, as usual, each month to the United States Coast and Geodetic Survey in Washington, D.C. The resident staff included the acting director, Mr. H. B. Sapsford, and four professional assistants, and in addition there was a locally recruited staff of ten.

Announcements

Prof. Eugène Darmois, professor of physics in the University of Paris, has been elected a member of the General Physics Section of the Paris Academy of Sciences in succession to the late Prof. Aimé Cotton.

In Memorandum No. 25 of the Medical Research Council, "The Social Consequences of Pneumoconiosis among Coalminers in South Wales", by Dr. P. Hugh-Jones and Dr. C. M. Fletcher (London: H.M. Stationery Office, 1951; 1*s*. 9*d*. net), methods of studying the connexion between dust and disease and the physiological assessment of shortness of breath are discussed. The two sections dealing with the improvement of human performance by laboratory studies include a valuable paper by Sir Frederic Bartlett on the laboratory analysis of human activities, and papers dealing with the effects of warmth on comfort and efficiency, physiological studies of the effects of heat, and anatomical factors in machine design.

UNIVERSITY COLLEGE, SOUTHAMPTON

DEPARTMENT OF ZOOLOGY

PROF. J. Z. YOUNG, professor of anatomy, University College, London, opened the new Department of Zoology at University College, Southampton, on December 5. In an address before the opening ceremony, which was attended by representatives of universities and other bodies, Prof. Young pointed out that although there are many reasons for the study of zoology, the most important is to satisfy our urge to become acquainted with the animals around us. He emphasized the richness of animal life still to be found in the British Isles, and suggested that the great abundance and variety of life in fresh-water ponds and streams, and even more especially in the sea, should merit our particular attention. With the importance of the fishing industry in Great Britain, it is clear that the study of marine life is of very considerable practical value. Prof. Young expressed the hope that the new Department would study animals in relation to their environment. At the same time experimental zoology, experimental embryology, anatomy and other methods of approach, he said, are essential to the study of the animal as a whole. In this connexion he welcomed the emphasis which is being placed in the new Department on comparative physiology. Even man and his environment may be regarded as a proper subject (though admittedly a very complex one) for zoologists to study. Thus the zoologist should be prepared to extend his thinking to anthropology and related subjects. But whereas on one side the study of zoology may march with philosophy, on the other hand it is just as needful, if we are to understand the working of animals fully, to enter the fields of biochemistry and biophysics. Zoology is therefore a fundamental science and at the same time an all-embracing subject requiring the most severe mental discipline. He hoped, therefore, that in Southampton zoology would not be too narrowly interpreted. The new and well-equipped laboratories, he said, mark an important step in the development of the subject with which Southampton can make a real contribution to biological studies.

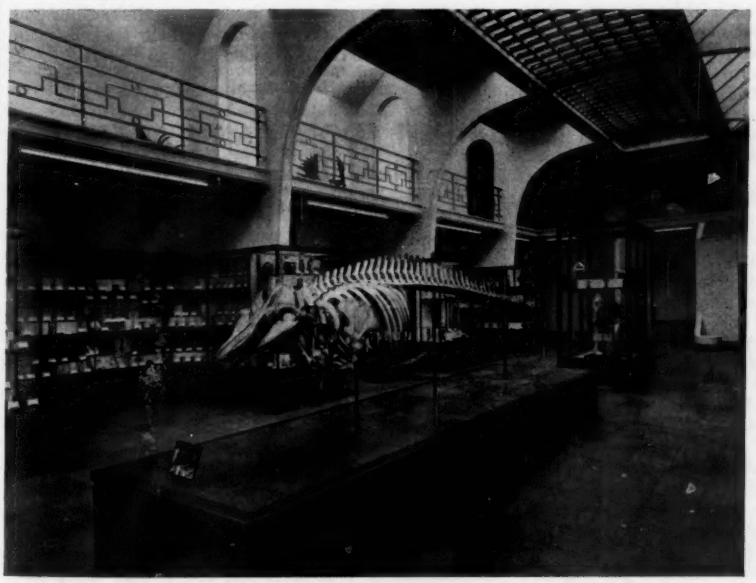
The new Department is a well-designed building of two floors, built of brick, and some 130 ft. long. It has been added to an existing block which once housed both the Geology and Zoology Departments, and between the old and new buildings a new zoological museum has also been erected.

The whole Department has been supplied with teak benching, and care has been taken in planning extensive cupboard, shelf and drawer accommodation. All laboratories and private rooms have been provided with ample electric power points. It has been possible also to provide microscopes, low-power binocular microscopes and general equipment for each laboratory in numbers sufficient to make each almost a self-contained unit.

On the ground floor the new Department houses a well-equipped physiology laboratory. This includes benches designed for kymograph work, as well as chemical and embedding benches and a smoking and fume cupboard. Near by is a dark room reserved for physiological work. Apart from general equipment, the physiology laboratory is furnished with recording apparatus, refrigerators, a Spekker photoelectric absorptiometer, direct-reading balances and a respiration bath.

Across the corridor from the physiology laboratory there is a well-ventilated and lighted animal house with stocks of 'pure line' rats, mice and guinea pigs housed in racks of metal cages. Special heated aquarium sinks also maintain a colony of 250 South African toads (*Xenopus*). These are being used mainly for research on the pituitary and the physiology of colour change. The mammal stocks are used for research into growth hormone, adrenocorticotropic hormone and other endocrine gland effects, and also as stock for teaching purposes. Both the animal house and the nearby preparation room, which is fitted with a large tiled dissecting slab and work bench, have concrete floors to facilitate washing.

There is a cold room of generous proportions which is capable of giving constant temperatures (*c.* ±0·5) from 0° C. up to room temperature. This is made possible by a large refrigerating unit and a system



Zoological Museum, University College, Southampton

of fans and ducts to circulate the cold air. The room is insulated throughout by a double layer of cork, faced with white polished asbestos boarding. Daylight is admitted by a vacuum-insulated window; but the room can rapidly be converted into an experimental dark room with controlled lighting. Three large concrete tanks with heating units have been built into the cold room so that constant-temperature baths at different temperatures can be operated at any one time.

An aquarium room with compressed air supply is also situated on the ground floor. Both the aquarium and cold rooms are already in use for experimental work on marine and freshwater animals. The aquarium room includes two large slate storage tanks for living animals, in addition to the usual small tanks.

The new building is equipped with a departmental photographic dark room and a small developing room. Equipment in the photographic room includes an optical bench with photomicrographic apparatus and an enlarger for both micro-film and ordinary-size negatives.

The ground floor also has three lecturer's rooms, a technician's room, a large research room occupied by two postgraduate students and a room equipped with sterilizing ovens and an autoclave. Store rooms for glassware, chemicals, general equipment and one for nets and other ecological apparatus complete the ground floor. A small lift for goods serves both floors of the building.

On the upper floor, apart from the professor's room, two lecturer's rooms and a research room, there are three laboratories, two of which, planned to accommodate about thirty students each, form part of the old block. The remaining new laboratory has been planned as a 'final honours' room, designed to take a dozen students. Each student has ample bench and cupboard accommodation, and the room has also been fitted with a small lectern and blackboard so that it can be used as a lecture and discussion room.

There is a small lecture theatre, capable of seating some sixty students and fitted with an epidiascope which can be sunk into the lecture bench, and also a departmental library equipped with steel shelving to take about four thousand volumes and with study space for about a dozen students. This library houses the majority of the zoological books in the College, and also includes a good selection of full runs of the more important journals in both zoology and physiology.

The new departmental museum, of modern design, measures some 70 ft. × 35 ft. It is lighted by a glass roof supported by four main reinforced concrete arches spaced along the length of the room. A narrow gallery, with 'Lenscrete' panels in the floor to increase the lighting, runs along three sides of the museum and is reached from the upper floor of the Department. The concrete arches mark off bays at the ground-floor level of the museum, and glass display cases, 7 ft. 6 in. high, framed with Australian walnut and bronze fittings, have been placed around the walls and bays. Heating units have been sunk into the lower parts of the cases.

The sliding glass panels give excellent views of the collections displayed. Both the day lighting and the fluorescent lighting, hidden largely in the glass roofing, have been specially planned to minimize reflexion from the glass of the cases.

The museum collections are arranged phylogenetically and include dissections and skeletal preparations, many of which have been made by students of the Department as part of their course work. Many specimens have also been generously given by other departments and museums. It is hoped that the museum, though designed primarily as a teaching museum for the Department, will also serve as a centre for the colleges and schools in the area, since Southampton lacks a municipal natural history museum.

The gallery has at present only storage cases housing a large part of the smaller specimens used for general class purposes; but it is hoped that further display cases will be added there in the near future.

The centre of the museum is occupied by a few of the larger exhibits, including an 18 ft. long skeleton of the pilot whale, *Globicephala*, which was prepared last year in the Department from one of the specimens stranded on the beaches at Dunbar. While the present collections are mainly systematic and morphological, ecological and other exhibits are planned for the future.

The new Department was viewed by visitors after the opening ceremony, and demonstrations of the research work now in progress were laid out in the lecturer's and research rooms. They included physiological studies on the endocrine glands, studies on the growth of *Mytilus* and the infection of *Mytilicola*, and factors concerned in the hatching and ecology of *Chirocephalus*. Studies on the respiration of marine Copepoda, and of growth of bones in trout, and some ecological investigations on streams and ponds, and on beech-woods were also demonstrated.

The Department emphasizes ecological work, with the sea and the New Forest area (with its varied streams and woodland) only a few miles away. A small boat is operated in Southampton Water by the Department. At the same time, ecological work is combined so far as possible with experimental zoology. The facilities available for comparative physiology have been planned with the aim of developing this subject both as regards teaching and research.

Students also exhibited some of the dissections and preparations and special studies which they have in progress as part of their normal degree work.

BRITISH FOOD MANUFACTURING INDUSTRIES RESEARCH ASSOCIATION

OPENING OF NEW LABORATORIES

LADY ENGLEDOW, wife of Sir Frank Engledow, Drapers' professor of agriculture in the University of Cambridge, on November 8 cut a ceremonial ribbon stretched across the entrance and declared open the fine new laboratories at Leatherhead of the British Food Manufacturing Industries Research Association.

The Association was formed in the beginning of 1947 by the amalgamation of two much older research organizations. Although nominally only in its fifth year, its work, which covers a broad (and ever-widening) field of food processing and preservation, is a continuance of research that has been developed during the past thirty-two years. In 1919, the British Association of Research for the Cocoa, Chocolate, Sugar Confectionery and Jam Trades was formed as

the result of the co-operation of manufacturers in these three fields. Premises were fitted out as laboratories in Holloway, and research commenced under the directorship of T. Macara. In 1925 a further group of food manufacturers, mainly concerned with meat and fish products, set up the British Food Manufacturers' Research Association, at the same address and under the same director of research.

The two organizations continued to work in close association, but retaining their separate entities, until 1946, when amalgamation was decided on and plans drawn up for the construction of new laboratory premises at Leatherhead. In the meantime Mr. Macara had retired and had been succeeded as director of research by Dr. L. E. Campbell. At the first general meeting of the new Association, held in March 1947, Sir Frank Engledow was elected president, an office he still holds. The new laboratories were completed towards the end of 1950. Dr. Campbell relinquished his post in May of this year to join the United Nations Food and Agriculture Organization in Rome, and Dr. F. H. Banfield, who had been deputy director since 1948, took over as director of research.

On the opening day and on the day following, the laboratories were open for inspection by members of the Association and those interested in food research. Between four and five hundred visitors attended and studied the exhibits arranged in the laboratories to illustrate the work and scope of the Association. With a floor area of more than 19,000 sq. ft., the building has been planned on modern lines and the laboratories laid out and equipped in a most up-to-date manner. There are general laboratories accommodating teams of laboratory workers, specialized laboratories such as that devoted to micro-biological investigations, a number of small laboratories housing one or two research workers, a large technical laboratory equipped for carrying out a range of factory processes on a small scale, and a spacious library containing some thousand books and ninety periodicals. The staff numbers about sixty, including some thirty graduates.

The work of the Association is balanced to cover the interests of the various groups of member firms. These groups include manufacturers of bakers' prepared materials, cocoa and chocolate, jam, margarine and compound cooking fats, meat and fish products, pickles and sauces, sugar confectionery, and various miscellaneous products, such as jelly tablets, starch and flour preparations, lemon curd, etc. Research being undertaken falls into two main categories: fundamental research, such as the investigations of problems connected with the rancidity of fats, and research into specific problems arising in connexion with particular manufacturing processes.

Of the general apparatus and equipment displayed on the two days that the laboratories were open, mention may be made of the exhibits designed to illustrate the various methods for the estimation of moisture in foods, the recording of the colour of foodstuffs, the measurement of the strength of gels, the measurement of the viscosity of chocolate and the use of refractometers in factory control. Among the demonstrations of application were the determination of air in margarine, the examination of the aerating properties of egg albumen and its substitutes, detection of fermentation in foodstuffs, measurement of particle size with particular reference to particles of sugar in chocolate, and the study of the properties of starch gels and pastes. For the last-mentioned purpose two viscometers were shown, the Shirley consistometer and the corn industries viscometer. Another instrument recently installed is the Unicam photoelectric absorption spectrophotometer with application to the estimation of vitamin A in marine animal liver oils. Other investigations being undertaken by the Association which were fully demonstrated to visitors were those in connexion with the effect of various methods of cooking on the digestibility of meat proteins, the shrinkage of meat and fish pastes in jars, the sedimentation of sauces, the preparation of gelatine from pork rinds, and the corrosion resistance of stainless steels and other alloys to the action of fruit juices, pickling brines and similar products.

In the micro-biological laboratory both the desirable and undesirable activities of micro-organisms in the preparation of manufactured foods are under investigation. Among desirable activities is the part played by bacteria in the curing of bacon in brine, and in the brining of vegetables. The growth of micro-organisms in pickles or canned goods or of mould on jams is, however, clearly undesirable. Strawberries preserved for jam-making in sulphur dioxide are sometimes subject to a breakdown as the result of the activity of enzymes, and investigation into the exact nature of this action is a subject of research.

A short account of the work of the Association would not be complete without mention of some of its other manifold activities. The suitability of fruits for commercial jam manufacture is one important item, and samples of jam prepared in the laboratories were displayed for inspection by visitors. In the entomological laboratory the means for the identification and control of pests liable to infect raw materials are under continual review, as are the methods of controlling rodents.

Analysis of foodstuffs plays a most important part in food manufacture. The extensive laboratory at Leatherhead devoted to this purpose is fully engaged in the testing of new official methods and the development of methods of analysis suitable for routine factory control. The part played by the Association in assisting members to conform to the standards demanded by modern conceptions of purity in foods, and with the food laws of the countries to which their goods are exported, is of the greatest help to members.

GEOLOGY AND MINERAL RESOURCES IN THE BRITISH COLONIES

THE first number of the second volume of the quarterly bulletin issued by the Mineral Resources Division, Colonial Geological Surveys, which has recently been published by H.M. Stationery Office, gives further evidence of the valuable work being done by the expanded Geological Surveys of the Crown Colonies, and of the advantages gained from the limited measure of central organization which came into being after the Second World War.

Much space in this volume is devoted to an article on Sierra Leone, by J. D. Pollett, director of the Geological Survey Department of the Colony. The benefits of government-sponsored geological investigation are here illustrated particularly well. Although the first survey of the Colony, during 1918–21,

failed to find any minerals of economic value, the investigations by Dr. N. R. Junner while director from 1928 onwards revealed high-grade iron ore, industrial diamond deposits, chromite, ilmenite and alluvial gold. Of these the first two mentioned have now reached major importance, more than 11,000,000 tons of hæmatite and 10,000,000 carats of diamonds having been exported during 1930–49.

Sierra Leone is mainly underlain by rocks of Pre-Cambrian age, of which approximately half the total area is granite. This is intrusive into metamorphic rocks, the schists, gneisses and granulites of the Kasila Series, the Kambui Schists and the Marampa Schists. The granite is overlain by folded unfossiliferous sediments, the Rokell River Series, and these in their turn are covered unconformably with bedded arenaceous rocks believed to be equivalent to Grès Horizonteaux of French Guinea, where fossil evidence indicates a Middle Silurian age. The primary iron-ore deposits consist of schistose specular hæmatite in the Marampa Schists, and banded iron-formation in the Kambui Schists. Near the surface, intense lateritic weathering has produced dense secondary hæmatite. The Colony peninsula is underlain by a banded noritic complex, including troctolite and gabbros, apparently lopolithic in form, and having other features in common with the great Bushveld lopolith in South Africa, including the presence of platinum.

Maps showing the geology and distribution of mineral localities on a scale of 1 : 1,000,000 accompany Mr. Pollett's article. Surveying of the Colony on the 1 inch : 1 mile scale has now begun with the expanded staff made possible by a grant from the Colonial Development and Welfare Scheme.

Under "Notes and Abstracts" an account is given of one of the first results of the recent effort to interest home university geological workers in Great Britain in problems of Colonial geology. A visit by Drs. J. Sutton and Janet Watson to Tanganyika to examine the granites and basement rocks is described in some detail; Prof. W. Q. Kennedy visited Uganda.

The issue also includes articles on British Somaliland and on photogeology, and a laboratory report on glass sand from Nigeria. Reports from the various Geological Survey units indicate that geological work of considerable scientific interest as well as economic value is in progress in many parts of British Colonial territories.

K. C. Dunham

PALATABILITY OF BIRDS' EGGS

In a paper submitted to the Zoological Society of London (*Proc. Zool. Soc. Lond.*, 121, Part I), Dr. Hugh Cott describes the results of an investigation into the relative acceptability of the eggs of twenty-five species of birds, belonging to ten orders, as illustrated by the feeding preferences of the hedgehog (*Erinaceus europæus*). In each of 332 experiments, one of four animals used as tasters was presented with a choice between two egg-samples. Possible disturbing factors such as differences in egg-size or shell-coloration, and those due to spatial arrangements of the samples, were eliminated by the use of raw egg, offered in equal quantities, and by the successive reversal in position of the egg-species matched within a particular group of experiments, or as offered to a particular experimental animal.

The reliability of the experimental method and the degree of consistency of hedgehog discrimination was checked by repetition experiments (between the same species-pair), both for the same and for different individuals; and by linking and overlapping experiments (between pairs of egg-species more or less widely separated in the edibility series). In general, the results show the hedgehog to be sensitive to differences in the relative palatability of the eggs offered, and to be consistent in its preferences and aversions; these show a broad agreement with those of man for the egg-species considered.

The experiments, which fall into groups carried out with sixty species-pairs, afford a basis for the arrangement of the several species in a provisional hierarchy of preference. The species fall broadly into three grades, and in descending order of acceptability are as follows: (*a*) palatable—kittiwake, eider, razorbill, gannet, domestic fowl, lapwing, common tern, coot; (*b*) intermediate—wood-pigeon, little owl, rook, puffin, magpie, jackdaw, hobby, kestrel, little grebe, buzzard, arctic tern, ringed plover; (*c*) distasteful—blackbird, chaffinch, sedge-warbler, whitethroat, linnet.

It is believed that the preferences shown by hedgehogs are likely to correspond with those of other egg-eating animals, and that, within the limits of the series examined, they afford a satisfactory basis for consideration of the data in general terms. The wide range in specific edibility rating found to occur within certain orders suggests that relative acceptability may be largely independent of systematic status; however, the low mean edibility rating for passeriform species indicates a trend towards nauseousness within this order. No close or obvious connexion has been traced between relative acceptability of the egg and feeding habits of the parent; nor is the quality of the egg at all constantly related to that of the flesh in the species examined.

Yet the experimental results also point towards correlations between relative acceptability and various other ecological factors likely to influence susceptibility to attack by predators. First, there is a broad direct relationship between palatability of the egg and size of the parent. Secondly, the distribution, in terms of acceptability, of species having colonial and solitary nesting habits, respectively, shows a marked tendency for eggs of the former to be more, and those of the latter to be less, palatable. Thirdly, consideration of egg-palatability in relation to nest-site indicates that eggs laid in open nests in moderate growth or low herbage may be relatively distasteful as compared with those laid in various other situations. Fourthly, a general correlation is shown to exist between coloration of the shell and palatability of its contents. Broadly, cryptic eggs tend to belong to the higher edibility grades and distinctively marked eggs to the lower edibility grades.

Cott has also assessed the several species in terms of relative vulnerability, account being taken of such factors as size, weapons of defence, powers of offence, availability of the clutch, general habits, sociability and coloration. A general inverse correlation is shown to exist between the degree of vulnerability and that of acceptability—the most palatable eggs being those laid by non-vulnerable species, the most nauseous by those that are (otherwise) highly vulnerable. It is suggested that the facts point towards an adaptive interpretation of distastefulness in eggs, considered as a deterrent to attack; and that the distinctive coloration of nauseous, but otherwise vulnerable, eggs may have a warning or recognitional value in relation to potential predators.

REMANENT MAGNETISM OF ROCKS AND THE HISTORY OF THE GEOMAGNETIC FIELD

By J. HOSPERS

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IT is known experimentally[1] that the permanent polarization acquired by an igneous rock which has been cooled through the Curie point in magnetic fields of the order of the earth's field is considerably greater than the polarization obtained by exposing the specimen to the same field at room temperature. It is therefore likely that the present direction of polarization of an igneous rock as found in Nature is the same as that of the geomagnetic field at the time of its solidification, allowing for subsequent tectonic movements.

This opinion is supported by measurements of the direction of polarization of recent lava-flows. Chevallier[2] determined the remanent magnetism of lava-flows on Etna, of which the dates were known, and was able to trace the changes in direction from the twelfth to the seventeenth centuries, the later results agreeing with observatory determinations. Minakami[3] reports that the Yoridai-sawa lava-flow (erupted on July 12, 1940) actually became magnetized in the direction of the earth's magnetic field.

Thus from the measurements of the direction of remanent magnetism of igneous rocks have been inferred data on the history of the earth's magnetism, and many examples of apparent reversals of the field have been found. The most thoroughly investigated examples are the Tertiary tholeiite dykes of the north of England[4]; but many other instances have been discovered by magnetic surveys elsewhere in Great Britain, in Eire, Germany, Brazil and the Southern Transvaal (the Pilansberg dyke system[5]). Inverted remanent magnetism has also been found by measurements on specimens from a number of sills in Spitsbergen[6] and plateau basalts in Greenland[7]. In the summer of 1950, I took a number of samples from Icelandic lava-flows, which support the view that the geomagnetic field was reversed at the time of some of the eruptions.

In the area to the east of Akureyri in northern Iceland, two series of lava-flows can be distinguished; a lower series of thickness at least 3,000 metres, which we shall call here the 'Older Volcanic Series', and an upper series of at least 200 metres thickness (the 'Grey Phase'). The plant remains in sedimentary beds in the former indicate a Tertiary and probably Miocene age. Beds of glacial origin between the flows of the latter series indicate a Quaternary age. Fig. 1 gives a diagrammatic section of the flows at Merkjárgil canyon and in the Stóradalsfjall mountain where specimens, indicated by Roman figures, were taken. From their petrographic character it is clear that specimens I–VII belong to the Grey Phase and specimens VIII–XVI to the Older Volcanic Series.

In Fig. 2 the direction of the remanent magnetism of specimens I–VII is shown on a stereographic projection; in all specimens the north pole points downwards. In Fig. 3 the same is shown for specimens VIII–XVI, which belong to the Tertiary series. They fall into two groups, those in which the north poles point upwards (specimens VIII–XII) and those in which they point downwards (specimens XIII–XVI). It will be seen from Fig. 1 that they represent the upper and lower part respectively of the exposed Tertiary series. Thus the boundary between the Tertiary and the Quaternary series is characterized by the fact that the lavas above it show normal, and below it inverted, remanent magnetism.

In Fig. 4, the specimens of Stóradalsfjall are shown; in all except XXII, the permanent polarization is normal. The boundary between the two series could not definitely be established at Stóradalsfjall; but it was certain that the Grey Phase was present because moraines occur between the upper flows. It may therefore be inferred that the boundary between Grey Phase and Older Vocanic Series lies between the flows from which specimens XXI and XXII were taken.

The specimens can be divided into three groups: the normally magnetized Quaternary specimens I–VII and XVII–XXI; the inversely magnetized Tertiary specimens VIII–XII; and the normally magnetized Tertiary specimens XIII–XVI. The values of the declination and inclination of the mean direction for each of the three groups are given in the accompanying table, together with those of the present geomagnetic field in northern Iceland and those of the field of a geocentric axial dipole. In the fourth and fifth columns the angles between the above-mentioned mean directions and the present and the theoretical dipole field respectively are shown. The probability that the angle between the

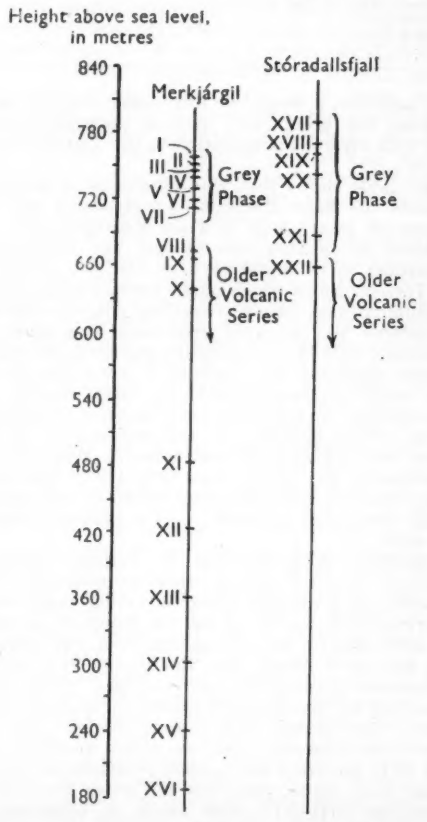

Fig. 1

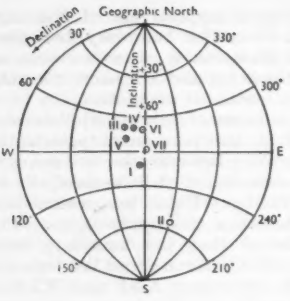

Fig. 2

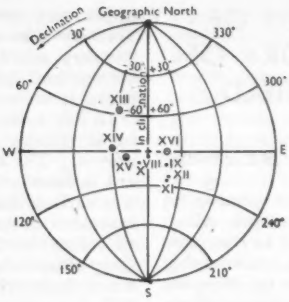

Fig. 3

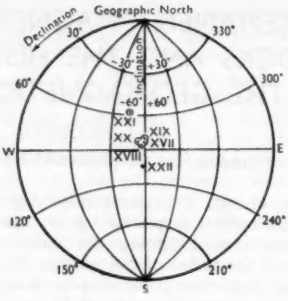

Fig. 4

⊙, Magnetic pole pointing downwards; ●, magnetic pole pointing upwards. Direction of remanent magnetism in (2) specimens I–VII, (3) specimens VIII–XVI, and (4) specimens XVII–XXII; no correction for dip of strata, which is 10° E. for all specimens

mean direction and the true direction exceeds the angular errors given in columns 4 and 5 is 5 per cent.

Table of Mean Directions, corrected for Dip of Strata

Specimens	Declination	Inclination	Angle with present field	Angle with dipole field
I–VII + XVII–XXI	N. 15° E.	+78°	9°±13°	4°±13°
VIII–XII	S. ½° W.	−70°	172°±11°	173°±11°
XIII–XVI	N. 27° W.	+72°	5°±33°	8°±33°
Present field (epoch 1945)[8]	N. 24½° W.	+77°	0°	5°
Dipole field (lat. 65° 44′)	0°	+77°	5°	0°

In addition, it should be mentioned that the angle between the group with normal polarization and that with inverted polarization in the Tertiary series is 172°.

The table shows that the differences in direction between the mean direction of polarization and the theoretical axial dipole field are not significant.

There are neither macroscopic nor microscopic differences to be found between the two groups in the Tertiary series which might have any bearing on the different magnetic polarization. Also it is difficult to ascribe the inverted remanent magnetism in specimens VIII–XII to pressure, reheating, recrystallization, lightning, etc., because it is not conceivable that these processes should only have affected the upper group. An inversion due to tectonic dislocations is out of the question, as top and bottom in the series can definitely be determined. Moreover, an inversion of the whole series would only mean that before the inversion the group which is now normal would have been reversed; so the problem remains the same.

Therefore, it seems that in Tertiary times in northern Iceland an inverted geomagnetic field existed. It is difficult to say anything exact about the time scale, but if one accepts Hawkes's estimate of 1,000 years for the average length of time between two successive flows[9], then the change from normal to inverted geomagnetic field occurred within 5,000 years and the inverted field existed for at least 25,000 years. This estimate follows from the fact that four flows occur between those from which specimens XII and XIII (inverted and normal polarization respectively) were taken, and that the series from which specimens VIII–XII were taken is composed of twenty-six flows.

The average intensity of permanent polarization is $4{\cdot}8 \times 10^{-3}$ c.g.s. units; the susceptibility is of the order of 10^{-3} c.g.s. units; the accuracy of the experimental determination of the direction of polarization is 4–6°.

In conclusion, I should like to thank Dr. J. McG. Bruckshaw and Mr. S. A. Vincenz, of the University of London, for the use of their measuring apparatus, Prof. R. A. Fisher for the calculation of the estimates of precision, and Dr. S. K. Runcorn for help and advice; also the Royal Dutch Shell Group of Oil Companies for a studentship. [June 21.

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ETHICAL PROBLEMS OF THE SCIENTIFIC WORKER

A CONFERENCE on the "Ethical Problems of the Scientific Worker", organized by the Cambridge Branch of the Association of Scientific Workers, was held in the Department of Physical Chemistry, Cambridge, during July 28–29.

The conference was opened by the president of the Association, Lord Haden-Guest, who spoke on the Hippocratic oath and its influence on the medical profession. He showed how the original pre-Christian Hippocratic oath laid down a code for a high level of professional honour, responsibility to the patient and respect for his private life, which in all essentials had been carried over into the later Christian version. The code has recently been re-affirmed in the Declaration of Geneva adopted by the World Health Organization in 1949; in this the medical practitioner swears, among other things, to consecrate his life to the service of humanity without regard for religion, party politics, race or social standing.

Lord Haden-Guest said he believes that medical men in all lands rarely fail to live up to the standards set by the oath. Although many of them do not sign an oath, its principles are inculcated into medical

students from their earliest days. Other professional people, including men of science, should be able to employ the medical oath as a model for a code applicable to their own work. Perhaps the medical man has an advantage, however, because he is in immediate contact with people, whereas many scientific workers, unless they are also teachers, tend to be isolated.

In the discussion which followed, Prof. W. I. B. Beveridge stated a number of ethical principles which he thinks should apply to the relations between individual scientific workers: the scientific worker should acknowledge the extent to which he is indebted to the work of others; he should avoid piracy of ideas and the claiming of an undue amount of credit in joint papers. On the whole, that which is best for the advance of science as a whole will be ethical, so far as the relations between men of science are concerned. Prof. Beveridge stressed also the need to maintain the international freemasonry of science, and gave his opinion that, while it is premature to codify these principles, they should be taught throughout the profession until they become a tradition.

Other speakers discussed the moral questions raised by biological warfare; this has come to be recognized as a very practical weapon and is being actively prepared. Men of science who are contributing, directly or indirectly, to these preparations have to face up to the moral responsibility of putting biological weapons into the hands of governments to be used against civilian populations. In a brief reply to these and other points of discussion, Lord Haden-Guest said that no form of warfare is humane and we must work to outlaw war. While the scientific profession can contribute to this, he thought that the responsibility of men of science is no greater than that of other people. The scientific worker has the advantage of a trained mind; but he must also study the problems of statesmanship if his opinion is to be of importance.

The second session was opened by an address by Dr. John Hammond on "Solving the World's Food Problems—a Practical Task for Science". Dr. Hammond surveyed the main problems of feeding the world's population under the heads, food production, transportation and nutrition, and showed how science is solving the difficulties arising in all these fields. On the production side, soil erosion is a frequent cause of low productivity, and not enough work is being devoted to finding inexpensive ways of preventing it. We should be prepared to learn from other countries: for example, Denmark has improved an originally poor soil by co-operative effort. Food supplies from Africa could be increased by irrigation. Plant breeders have made enormous contributions to food supplies, for example, by the extension of wheat-growing northwards in Canada. Similarly, the development of manurial treatment, the chemical control of pests, and artificial insemination, all based on scientific research, have led to great improvements in farming practice and productivity. Dr. Hammond said it is necessary for the agricultural scientist to be prepared for hard work without great material reward. His ethic should be based on what is good for people and not confined to what is good for science. It is not enough for men of science to be satisfied with their work if it does nobody any harm; it should contribute to human welfare.

In discussion, it was pointed out that Dr. Hammond's attitude, which admitted no limit to the possible production of food, is the best answer to the neo-Malthusianism of Vogt. Another speaker said that it is lack of concern for the needs of the native population, and not bad science, which has led to the monumental failure of the groundnuts scheme.

On the following day the proceedings were opened by Prof. C. A. Coulson, who discussed whether the scientific ethic should be based on religion. He said that the question of a scientific ethic cannot be discussed within the limits of science, and claimed that history has shown that science has always been guided by an ethic based on religion. This can be seen in the formulation of all the successive Hippocratic oaths and in the ethical concepts of Benjamin Franklin. Taking religion as a movement of the spirit, most of the great scientific figures of the past were religious. Prof. Coulson gave several examples to show how men of science are faced with the need for moral decisions involving considerations outside science, and it is necessary for man, as a social being, to base his actions on a code going beyond science. It might be possible for the Nazi scientists who experimented on human beings to say that they had added to scientific knowledge and thus that they had acted for the good of science, but this clearly did not provide a moral justification for their actions.

In discussion, a number of speakers, while agreeing that a moral code for scientific workers must be based on something more than solicitude for the advance of science, disputed Prof. Coulson's claim that religion is the main source of ethical concepts. It was further suggested that men of science, such as Newton, who used the phraseology of religion did so for reasons of convention or, in some cases, for fear of censure. Dr. G. Barnard, who supported this view, said that all the questions which were raised at the conference were essentially political and that Dr. Hammond's paper gave a glimpse of the kind of discussion which men of science could engage in once the political problems have been solved.

In the final session, Prof. N. F. Mott discussed whether men of science have a special social responsibility, and opened by giving his opinion that they certainly have. It is a dual responsibility: they have a duty to science itself and a duty to society to ensure that science is directed and used in a good way. The rest of society which uses science and feels its effects should participate in the control of science; but it is the men of science themselves, who know what science is and what its effects can be, who should have the largest share in the control. What we mean by 'good' is influenced by our education and religion, so ethical ideas will vary. The principle that "that which is ethical is that which is best for the advance of science" is a good code for fundamental research and is, indeed, already established in that field; but, as was shown by Prof. Coulson and others, it is not suited to applied research. Discussing the recent case of a nuclear physicist whose passport had been impounded, Prof. Mott said that this was the first time that such drastic action had been taken in peace-time against a person not accused of any crime. In his opinion, the Government's action was taken for fear of yet another shock to public opinion and particularly American opinion, rather than through any real fear of espionage. Men of science should protest at this, though their reasons for doing so would differ with their ethical and political opinions. As to participation in war-like research, Prof. Mott said there are

many different points of view, and those who wish to make propaganda on the subject should be careful to make it clear what their grounds are. Since decisions affecting science involve extra-scientific considerations, scientific research should continue to be based in the universities and not in government establishments, for in the universities it is easier for the scientific worker to maintain contact with specialists in other disciplines.

In discussion, Dr. E. V. Rowsell spoke of the scientific workers' responsibility to make public the potential consequences of their discoveries. They have no right to put such scientific discoveries as nuclear fission into the hands of governments without explaining to the layman what is involved. He contended that, if the public had fully realized the implications of the use of the atomic bomb, they would not have permitted it to be used, even to end the war with Japan. Prof. D. H. Peacock urged men of science to tolerate religion even if they do not themselves subscribe to it: religion might be as good an ethical basis for science as any of the alternatives that have been put forward.

Summing up the last session, Prof. Mott agreed that the special responsibility of the man of science lies in disseminating the consequences of scientific progress, while Prof. Coulson urged a search for a basis of agreement, for example, between religion and Marxism. True science, he said, is itself a religious activity, and religion and science are facets of something greater than either.

A. F. Brown
A. R. Trim

ASTRONOMY AT THE CAPE OF GOOD HOPE

ANNUAL REPORT FOR 1950

THE Report for 1950 of H.M. Astronomer at the Cape of Good Hope, Dr. R. H. Hoy, to the Secretary of the Admiralty has recently been published*. The report commences with a description of the buildings and grounds; certain modernizations of the residences have been undertaken and work on an improved water supply to the offices and residences has been started. Minor repairs were made to the dome of the Tower telescope and an improved gear fitted; leaks in the dome of the Victoria telescope can be repaired, but it is necessary to re cover the astrographic dome with 'Masonite', owing to its age and general condition. An account of the alterations to and use of the nine instruments follows, and in some cases there have been delays in adapting them to the scheduled programmes. Thus, while the modernization of the reversible transit circle went on throughout 1950, it was impossible to bring it back into routine use during the year, though it had been hoped that it would be in a fit state to start the new observing programme during the first half of 1951. The photometric cameras were received back from the Cambridge Observatory early in 1950; but they will probably remain unmounted until after the reversible transit circle is in active commission. The old gravity-driven clock for the Victoria telescope has been replaced by a small electric synchronous motor; the new compound cell for the 24-in. lens has been received from Messrs. Cox, Hargreaves and Thompson, Ltd.; but it has not yet been fitted. The Airy transit circle, which was used chiefly for making differential observations, has been dismantled as the observations can be made more accurately and more conveniently by the reversible transit circle.

Under "Astronomical Observations and Reductions" are included meridian observations, photographic star positions and proper motions, and stellar photometry, with seven subdivisions. An interesting matter arises under "Occultations" in connexion with the occultations of Antares in May and June. This star is one of the few occulted that can be expected to show a measurable diameter, and preparations were made at the Radcliffe and Cape Observatories to observe the May and June occultations photoelectrically with the object of measuring the durations of the occultations and from these deducing the apparent diameter of the star. Successful observations indicated a diameter of 0·04″, and it was realized that it would be a simple matter to time ordinary occultations to an accuracy of 0·01 sec. with a slight modification of this photoelectric apparatus. Arrangements have already been made for this, and it is hoped that occultations will be timed photoelectrically in the routine work. It may be pointed out that a photomultiplier photoelectric photometer has been in use for some time with the 15-in. reflector at Dunsink Observatory, and an occultation can be timed with an accuracy of one-hundredth of a second by this method (see *Irish Astro. J.*, 1, No. 6; 1951).

Other matters referred to in the Report are the time service, meteorological observations, publication of results and personal establishment. The last-named concludes with an account of the work of Dr. J. Jackson, who succeeded Sir Harold Spencer Jones at the Cape in March 1933, and who retired at the end of July 1950. This account pays tribute to Dr. Jackson's devotion to the parallax work in particular; during the Second World War, when many of the staff were absent on war duties, he personally made a large proportion of the necessary observations; and after the War, when the Observatory was fully staffed, he continued to observe up to the time of his retirement, especially on the photometry of the parallax stars. On relinquishing his appointment he was made a C.B.E.

* Report of H.M. Astronomer at the Cape of Good Hope to the Secretary of the Admiralty for the Year 1950. Pp. 15. (Cape of Good Hope: Royal Observatory, 1951.)

THE QUAIL IN BRITAIN

THE widespread impression that, in the British Isles, the quail used to be more a resident and less of a summer migrant is probably fallacious. There are still records of quail here every winter, and there is no evidence that the proportion of winter birds to summer birds is less than it ever was in the past. This and other problems of the biology of the quail have recently been discussed by R. E. Moreau (*British Birds*, **44**, No. 8, 257, August 1951).

Unlike the other game-birds, the quail is not represented by archæological or fossil material in the British Isles and there is no mention of it before the twelfth century. Evidently the bird never established itself here in the affections of the common people, as it did in Germany, where it was a cherished songster and unrestrained household pet. Nor in Great Britain or Ireland did the bird insinuate itself into proverbial sayings as it did in Germany, France and Italy. It

may be inferred, therefore, that it was less common in the British Isles, though there are enough contemporary references to show that some centuries ago quails were much more numerous and widespread here than they are now.

Towards the end of the twelfth century, for example, Giraldus Cambrensis reported "coturnices hic plurimi" in Ireland. In fifteenth-century literature the term "bevy of quails" occurs repeatedly. In 1466 quails (a hundred dozen) figured in the banquet given for Archbishop Nevill of York at Cawood, and in 1422 quails were included in the coronation feast of Henry VI.

In the sixteenth and seventeenth centuries significant references to quails are numerous: none of the English game-laws (eight up to 1714) mentions quail. But the birds were evidently an esteemed article of diet, and it may be inferred that up to 1700 the quail was a familiar bird in both Great Britain and Ireland and was usually regarded as rather a speciality for the table and probably diminishing, but still plentiful enough to be worth the bird-catcher's attention.

There are remarkably few direct references to the quail in the eighteenth century; but it is doubtful whether it diminished much. At the beginning Morton noted that "it comes into the sandy and warmer soil" of western Northants "at least a fortnight before it settles in the colder clayey part of the county".

There was undoubtedly a marked and progressive decline of quail in Britain in the first half of the nineteenth century; but this was accompanied by a marked increase in Ireland about 1845–50, when several nests could be found in one field. The subsequent decline, perhaps delayed until about 1865, was so marked that by the 1880's quail had almost totally disappeared from Ireland.

In 1865 More assessed the status of quail in Britain on the basis of questionnaires and concluded that "there are few counties in which the quail is considered to breed annually". In the remaining counties of Great Britain the quail was classed as "occasional". It seems that by about 1865 the quail in England had reached nearly the low ebb to which it fell in the twentieth century except for an occasional 'good' year.

To-day, systematic bird reports are produced annually for nearly thirty English counties. Quail records in these reports can be supplemented from the occasional county avifauna and from other records. These figures show that 1936 was the worst year in the twentieth century, the next worst being 1935 and 1940. Except for 1946 every year from 1944 onwards shows a more widespread recording of quail than any year before 1944.

In the present century there have been in the British Isles no quail years so outstanding as 1870 and 1893; but, allowing for various factors, it is probably true that at least twice as many quail visited Britain in 1947 as in any other year this century. 1947 was also a peak year in Belgium, Switzerland, Sweden and Holland.

Most of the records of quail in Britain are from areas of chalk, greensand and oolite. Of the eight most favoured counties six are dominated by these formations, and in them, as in Yorkshire, a very high proportion of the localities named in the quail records are calcareous. It is doubtful how far this correlation is due to preference for these soils and how far to preference for associated land-use.

Throughout its range the quail is a bird of open country, frequenting annual herbaceous growth, so that the deforestation of Europe must greatly have increased the area the bird can inhabit. There has been conflict of opinion about the effect of the subsequent agriculture. For example, in Norfolk the bird was said to like "rough fens", and its nineteenth-century decline has been attributed to the break-up of "coarse tussocky land". Others take the view that the decline of the quail was associated with "the great reduction in acreage of arable". Certainly the increase in quail since 1942 has accompanied a great increase in arable; but it must be recalled that in the first half of the nineteenth century, when arable was expanding in both Great Britain and Ireland, the quail was declining in the former as markedly as it was increasing in the latter.

While some have thought that clover fields are the favourite habitat of the quail, most observers believe that corn-fields are most frequented. Corn has been given as the quail's first preference in Germany, in Savoy and in Holland.

In Britain the prevalence of quail in corn as compared with other crops is likely to be accentuated by modern developments. On one hand the practices of grass-drying and silage-making lead to earlier cutting of some of the forage crops: on the other hand, increase in autumn-sowing of corn results in a bigger proportion of the area under corn being able to offer adequate cover to quail as soon as they arrive.

It is doubtful whether the decline of the quail population in the British Isles, which had to some extent a parallel in Western Europe as a whole, was due to changes in agricultural methods and in particular to the introduction of the mowing machine; human predation has probably been the most important factor in the decline of the quail population. Up to a few years ago exploitation on both sides of the Mediterranean was merciless in both spring and autumn, and the birds were not even left alone during the breeding season. From Egypt alone, as late as 1913, 1,858,000 quail were exported; with a general fall in the quail population the Egyptian exports in the years 1930–34 varied between 285,000 and 580,000, more than half the birds being captured as they were travelling north to breed. In 1937, import of live quail earlier than July was prohibited in both the main consuming countries, France and Britain, and the spring taking of quail was prohibited in both Egypt and French North Africa. The traffic in quail stopped in 1939 on the outbreak of war and has not been resumed.

Protection of quail visiting Britain has been inadequate and illogical. A hundred years ago, the stock had already been so reduced that no more should have been shot. Yet the quail still can be shot during the close season by owners and occupiers of land on their own land in nearly half the counties of England, including Berkshire, Cambridgeshire, Gloucestershire and Wiltshire, four of the seven counties in which quail are most likely to occur. The proposed new bird-protection legislation should stop these anomalies.

Moreau also discusses certain problems of quail biology and shows that information on the life-history of the quail is full of gaps and of conflicting information. In particular, investigation is needed into the relations of the sexes; it seems probable that mated males call little and that polygamy cannot be the rule. Though considerable attention has been given to the subject of the migration of the quail, it is far from being understood.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications

Statistical Methods in Anthropology

In their interesting letter in *Nature*[1] on statistical methods in anthropology, Dr. J. Bronowski and Mr. W. M. Long suggest that the reason why Prof. Zuckerman's findings were at odds with those based on classical comparisons was that he had compared each measurement separately instead of using the comprehensive test provided by the discriminant function. They took as an example the discriminant function calculated from measurements on forty human and forty-four chimpanzee lower milk canines. This gave a wide separation in the ranges of the two groups and conclusively indicated (*a*) that the Kromdraai and Taungs milk canines are not those of chimpanzees and (*b*) that they fall within the human range.

As it appeared to us unlikely (though not, of course, impossible) that a discriminant function would reveal such a distinct separation when a comparison of the individual measurements gave no indication of differences, we asked Prof. Zuckerman if he could furnish us with his measurements on this tooth. These consisted of four measurements, the labial height (H_1), the lingual height (H_2), the maximum anterior-posterior dimension (L), and the labial-lingual breadth (B), on twenty human teeth and twenty-seven chimpanzee teeth, together with data for four fossil lower canine milk teeth for each of which two or three of the above measurements were available.

A full analysis of these data was performed, calculating discriminant functions on all combinations of two, three and all four of the measurements. The results of this analysis are shown in condensed form in the accompanying table, with the exception that measurement H_2 has been omitted, since it was not available for any of the fossils. The first column of the table shows the measurements on which the discrimination is based, and the second the separation of the groups in terms of the mean difference d divided by the estimate of the standard deviation of a single individual within groups s, a plus sign indicating that the chimpanzee has the larger mean measurement or function. The remaining columns show the differences d_1 and d_2, divided by s, of each specimen from the means of man and chimpanzee respectively. If errors in the population means, variances and covariances are ignored, values of d_1/s or d_2/s greater than 1·96 or 2·58 indicate probabilities of less than 1 in 20 or 1 in 100 that the specimen belongs to that group on the evidence of that measurement or function. Errors in the means, etc., may here be substantial, but are progressively reduced as the amount of basic data is increased.

It will be seen that all three measurements for *Paranthropus robustus* (the Kromdraai skull) are similar to those of man, but are significantly different from those of the chimpanzee. For *Paranthropus crassidens* both measurements are similar to those of man, and the B measurement is very significantly different from that of the chimpanzee. We may therefore conclude that these teeth are definitely not those of chimpanzees, and resemble those of man, at any rate in these measurements. The measurements of *Plesianthropus transvaalensis* are close to those of the chimpanzee, but the differences from those of man are not fully significant. In all these cases the values of the discriminant functions merely confirm these findings. For *Australopithecus africanus* (the Taungs skull) the discriminant function indicates a close similarity to man, whereas the L measurement shows an almost significant divergence, suggesting in conjunction with the B measurement that the specimen may belong to neither group.

This last specimen provides an example of an important point which has not been mentioned by Bronowski and Long, and which is quite distinct from their point about fakes. A discriminant function, as its name implies, is designed to enable objects known to belong to one of two groups to be assigned to the correct group. If used for classifying an object that does not belong to either group, it may erroneously indicate that the object belongs to one of the groups, whereas other evidence from the measurements may show quite conclusively that this is not the case. An examination of the value of each individual measurement of the object to be classified in relation to the means and standard deviations of the corresponding measurement for the two groups is an essential first step in avoiding errors of this kind.

In our example, H_1 is the best single measurement for discrimination. If we have a collection of specimens which, in fact, belong to one or other of the groups and rely on this one measurement, it will classify 69 per cent at the 1 in 20 level (43 per cent at the 1 in 100 level), leaving the remainder in doubt, while the discriminant function on H_1 and B will classify 85 per cent and 63 per cent respectively. If those which are doubtful are assigned to one or other group, depending on which mean is the closer, the percentage misclassification will be 14 per cent using H_1 alone and 9 per cent using H_1 and B. The remaining variates, H_2 and L, give a negligible increase in power of discrimination.

The power of discrimination between man and chimpanzee revealed by these results is much less than that obtained by Bronowski and Long from their data. It is clear from the diagrams published in the communication in *Nature* from Le Gros Clark[2] that it is the combination of the two anterior-posterior measurements used by Bronowski and Long which gives the very sharp discrimination, due to the difference in form of the two groups of teeth. It is very probable that a comparison based on the

Measurements	d/s	*Par. robustus*		*Par. crassidens*		*Ples. transvaalensis*		*A. africanus*	
		d_1/s	d_2/s	d_1/s	d_2/s	d_1/s	d_2/s	d_1/s	d_2/s
H_1	+ 2·15	− 0·36	− 2·50						
L	+ 1·68	− 1·40	− 3·09	+ 0·72	− 0·97	+ 1·46	− 0·69	+ 1·93	+ 0·25
B	+ 1·95	− 0·65	− 2·60	− 1·71	− 3·65	+ 1·78	+ 0·10	− 0·91	− 2·86
H_1L	+ 2·36	− 0·89	− 3·25						
H_1B	+ 2·66	− 0·63	− 3·30			+ 1·88	− 0·48		
LB	+ 2·08	− 1·05	− 3·13	− 0·89	− 2·97			+ 0·18	− 1·90
H_1LB	+ 2·67	− 0·72	− 3·39						

means and variances of these individual measurements would, in fact, have given quite decisive results. Almost certainly the use of a simple ratio would have done so. This contrast in power of discrimination emphasizes the importance of a proper choice of measurement to bring out differences of form which may, in fact, exist between the two groups. It is this choice, not the elaboration of statistical procedure, which has led to the greater power when two anterior-posterior measurements are used.

It will be noted that in the case of the Kromdraai skull Zuckerman's measurements are themselves decisive. This is at variance with the conclusions of Ashton and Zuckerman[3]. The matter is commented on in the following letter from Prof. Zuckerman.

Apart from these fundamental considerations, the practical application of discriminant functions and of the more generalized type of function referred to in the last paragraph of Bronowski and Long's communication is not so simple as they imply. Briefly, the difficulties are: (*a*) the need for very heavy computations when any large number of variates are involved; even the elimination of the less-important variates on the lines followed by Miss Barnard in her original paper on the subject[4] requires extensive numerical work; (*b*) the difficulty of calculating discriminants from data which are to any considerable extent incomplete; (*c*) the fact that a discriminant function, so calculated, is applicable to a complete set of measurements; if a discriminant function has been calculated for use with measurements *a*, *b*, *c* and *d*, a new function will be required for a specimen for which only measurements *a*, *b* and *d* are available.

This last difficulty is perhaps not of much importance with a single fossil tooth, since it should normally be possible to make all the necessary measurements; but it becomes of great importance when more than one tooth from the same fossil exists, and is equally troublesome with parts of the skeleton which are more subject to damage.

None of these difficulties is insuperable, and (*b*) and (*c*) are not always encountered. With modern developments in relay and electronic calculators, we may expect to see a considerable extension of the discriminant type of analysis; but the fact remains that up to the present time the published examples must be regarded more as examples of method than as practical contributions to comparative anatomy.

At the present stage of development of the subject, therefore, we must not rule out simpler and more empirical methods, even when these methods are not so logically satisfying as a proper discriminant or principal component analysis would be. In particular, the use of means and standard deviations of individual measurements gives a method of comparison which is rapid, easily calculated, and universally applicable, however fragmentary the basic measurements and the measurements of the particular specimen under examination may be. As pointed out above, it is an essential first step, which can be supplemented by more elaborate multivariate analysis where this appears necessary and feasible.

In conclusion, we would like to make it clear that this communication should not be taken as implying that we regard the use of measurements as necessarily likely to make large contributions to the subject of comparative anatomy. The fields in which they can be effectively used may well be rather limited. When, however, there are no differences in anatomical features or easily recognizable differences in shape, the metrical approach is the only one possible.

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Nov. 30.

[1] Bronowski, J., and Long, W. M., *Nature*, **168**, 794 (1951).
[2] Le Gros Clark, W. E., *Nature*, **166**, 791 (1950).
[3] Ashton, E. H., and Zuckerman, S., *Phil. Trans. Roy. Soc.*, B, **234**, 471 and 485 (1950).
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WE are greatly indebted to Dr. Yates and Mr. Healy for having brought to light, in the course of the computations they record above, the fact that our previous estimates[1] of the standard deviations of the individual measurements of the teeth of the anthropoid apes are in error, and that our published figures need to be divided by $\sqrt{2}$. The mistake was due to a misunderstanding in the interpretation of the analysis of variance which was carried out to separate the component of variance that is due to differences between corresponding teeth in the same jaw and that due to differences between animals. The standard errors of the means of the dimensions are correct as published.

Because of this error, which we very greatly regret, a number of differences between the overall dimensions of the teeth of the Australopithecidæ and those of existing apes emerge as insignificant statistically in our previous comparisons[2], whereas they are significant when made on the basis of the corrected figures. We are happy that the adjustment will help to reconcile some points at issue that have been discussed elsewhere[3]. Thus our previous comparisons included observations on some thirty specific statements (of a qualitative kind) that had been made by other workers about the relation of the overall dimensions of the teeth of the South African fossils to the corresponding measurements in living apes, and corroborated only about 20 per cent. The figure is 50 per cent in the revised comparisons.

In the analysis which revealed our error, Dr. Yates and Mr. Healy have fortunately shown, in the case of the teeth they consider, that the various possible methods of statistical approach to the problem lead to a common conclusion. We believe the controversy has also been of value in so far as it has indicated very clearly the many difficulties that exist in the adequate statistical treatment of data of this type. Since measurement must always be one of the basic methods of comparative morphological studies, the resolution of these difficulties is, we believe, a matter of some importance.

In our previous paper[2], we were concerned with the comparison of the linear dimensions of the teeth of fossil hominoids with those of existing apes. A more comprehensive study in which the dimensions of human teeth are also considered is now in progress. The data about the dimensions of the teeth of anthropoid apes that we are now using include not only those previously analysed, but also the overall measurements of the teeth of all the chimpanzee and gorilla skulls in the Powell-Cotton Museum, Birchington, as well as those of a new collection of orang skulls made available to us by Dr. W. R. Geddes. This has in any event made it necessary to recompute our basic data, so that an opportunity will be provided for publishing revised figures for the variance of the dental dimensions of the apes, and at the same time to qualify, where necessary, observations about the

existence or lack of existence of significant differences between the overall dimensions of the teeth of living and fossil hominoids. We are also planning to explore the possibility, where necessary, of constructing more elaborate multivariate functions of the type referred to by Bronowski and Long in the last paragraph of their communication[4]. Our previous experience[5] leads us to doubt, however, whether it will be practicable to construct functions which include the measurements of more than one tooth. If we are right in this view, the problem of combining the evidence from a number of teeth belonging to the same fossil skull will still remain.

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[1] Ashton, E. H., and Zuckerman, S., *Phil. Trans. Roy. Soc.*, B, **234**, 471 (1950).
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[3] Clark, W. E. Le Gros, *Nature*, **165**, 893 (1950); **166**, 791 (1950). Zuckerman, S., *Nature*, **166**, 158 (1950); **166**, 953 (1950).
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[5] Ashton, E. H., and Zuckerman, S., *Proc. Roy. Soc.*, B, **138**, 354 (1951).

Formation of Carbon Monoxide in Connexion with Hæmoglobin Catabolism

In an earlier communication[1], an account was given of investigations indicating that carbon monoxide can be formed in blood on incubation at 38° C., especially at acid or alkaline *p*H's or after addition of sodium azide. These observations formed the basis for further investigation.

Both change of *p*H and addition of sodium azide also cause an increase in the oxidation of hæmoglobin to methæmoglobin. It was possible to show that there was a relationship between the formation of carbon monoxide and of methæmoglobin, but this was not a simple quantitative one. If methæmoglobin was incubated at *p*H 7·4 or 6·5, however, there was no appreciable increase in concentration of carbon monoxide. Thus it seems that the formation of carbon monoxide is not secondary to the conversion to methæmoglobin, but that the two processes are in some respect parallel.

Since the conversion of hæmoglobin to choleglobin also shows a parallel relation to the oxidation of hæmoglobin to methæmoglobin, it was considered of interest to investigate the relationship of the formation of carbon monoxide to the breakdown of hæmoglobin to bile pigments.

According to Lemberg, Legge and Lockwood[2], this reaction is greatly accelerated by small amounts of ascorbic acid singly or together with glutathione. Hydrogen peroxide also has the same effect. As may be seen from Tables 1 and 2, these substances also give considerable increases in carbon monoxide. In the hydrogen peroxide experiments, the catalases in the blood were inhibited by warming the blood to 65° C. or by adding sodium azide. The amounts of carbon monoxide formed in these experiments correspond to a conversion of up to 15 per cent of the initial hæmoglobin to carboxy-hæmoglobin. At the same time it was possible to observe the development of a greenish colour in the blood, corresponding to the production of choleglobin.

The formation of carbon monoxide in connexion with hæmoglobin catabolism may be explained by the assumption that it is split off when the tetrapyrrole ring is opened. According to the generally accepted hypothesis, first advanced by Lemberg[3], the ring is opened by expulsion of a methene group in the α-position. This seems to occur after oxidation to —C—OH and subsequent dehydrogenation. Thus it seems possible that the —CO group formed in this way might be split off.

Table 1. Effect of Ascorbic Acid on Formation of Carbon Monoxide in Hæmolysed Blood (diluted 2·5 : 25 ml.) during Incubation at 38° C.

Sample	Ascorbic acid (mgm.)	Incubation time (hr.)	Warmed to 65° C.	% COHb calculated on initial Hb-conc.	% COHb in controls without ascorbic acid	Remarks
1	5	20	−	2·6	1·6	
2	5	20	−	2·6	1·6	
3	10	20	−	4·3	1·6	
4	10	20	−	3·5	1·6	
5	10	20	−	5·3	1·6	+ 50 mgm. glutathione
6	10	20	−	5·0	1·6	+ 50 mgm. „
7	25	1	−	2·6	1·4	
8	25	1	−	2·7	1·4	
9	25	1	+	2·9	1·2	
10	25	1	+	2·6	1·5	
11	25	20	+	15·7	1·6	
12	25	20	+	10·7	1·2	
13	25	20	−	13·1	1·6	
14	25	20	−	15·4	1·6	
15	25	20	−	14·0	1·6	

Table 2. Effect of Hydrogen Peroxide (1 : 5) on the Formation of Carbon Monoxide in Hæmolysed Blood (diluted 2·5 : 25 ml.) incubated at 38° C.

Sample	% H_2O_2	Incubation time (hr.)	Ascorbic acid (mgm.)	Warmed to 65° C.	Addition of NaN_3 1 : 200	% COHb calculated on initial Hb-conc.	% COHb in controls without H_2O_2 and ascorbic acid
1	0·03	1	—	+	−	3·7	1·4
2	0·03	1	100	+	−	3·8	1·4
3	0·03	20	−	+	−	3·4	1·6
4	0·03	20	100	+	−	5·1	1·6
5	0·03	20	100	+	+	9·5	1·9
6	0·03	20	100	−	+	9·6	1·5
7	0·08	1	—	+	−	5·9	1·5
8	0·08	1	25	+	−	13·3	1·5
9	0·08	20	−	+	−	4·7	1·2
10	0·08	20	25	+	−	13·6	1·2
11	0·08	20	25	−	+	14·3	2·1
12	0·08	20	25	+	+	10·8	2·5

The molecular relationship between the breakdown of hæmoglobin and the production of carbon monoxide that would be expected from this hypothesis can, in fact, be demonstrated experimentally. The amount of carbon monoxide exhaled per day by a subject was calculated from repeated determinations of the concentration of carbon monoxide in the expired air during several days, and from the average respiratory volume. This came to 6·8 mgm. carbon monoxide per day, while an approximate estimation of the amount of hæmoglobin broken down in one day (calculated from the total hæmoglobin and an average life-span of the erythrocytes of 120 days) was 4 gm. The relation between these values is 1 : 590, while the relation between the molecular weights of carbon monoxide and of hæmoglobin is 1 : 600, if the latter is calculated for each hæmin group.

The endogenous formation of carbon monoxide and its relation with hæmolysis and internal hæmorrhage[4] may be explained on the assumption that carbon monoxide is liberated in connexion with the *intra vital* breakdown of hæmoglobin.

A detailed account of these investigations will be published in *Acta physiologica Scandinavica*.

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Enzymatic Conversion of the Stereoisomers of *iso*Leucine to the Corresponding α-Keto-Acids

THE optical isomers of α-keto-β-methylvaleric acid have been prepared by enzymatic oxidation of the corresponding D-amino-acids[1]. The keto-acid isomers (and their 2,4-dinitrophenylhydrazones) prepared by enzymatic oxidation of D-*iso*leucine and D-allo*iso*leucine exhibited optical rotations which were equal in magnitude and opposite in direction[1,2]. Furthermore, from microbiological studies (to be reported in detail elsewhere), a purity of at least 98 per cent may be assigned to the lævorotatory isomer of α-keto-β-methylvaleric acid prepared by enzymatic oxidation of D-*iso*leucine. These findings indicate that the configuration about the β-carbon atom is not measurably altered by enzymatic oxidation of the D-amino-acids or during isolation of the keto-acid.

It has now been found that oxidation of the L-isomers of *iso*leucine and allo*iso*leucine by L-amino-acid oxidase of snake venom, or transamination between these amino-acid isomers and α-ketoglutaric acid catalysed by a soluble hog's heart preparation, leads to similar results, that is, formation of optically active keto-acid isomers which have been isolated as the 2,4-dinitrophenylhydrazones. The experiments with snake venom oxidase were carried out essentially as described for those with D-amino-acid oxidase, except that crystalline beef liver catalase was added to prevent further oxidation of the keto-acids. In the transamination reactions, which did not go to completion, the α-keto-β-methylvaleric acid formed and the residual α-ketoglutaric acid were precipitated by addition of 2,4-dinitrophenylhydrazine. The hydrazones of α-keto-β-methylvaleric acid and α-ketoglutaric acid were separated by counter-current distribution using ethyl acetate and aqueous sodium carbonate as the solvents. The hydrazones were recrystallized from water, dried, and characterized by nitrogen analysis and melting point. The specific optical rotations of the 2,4-dinitrophenylhydrazones of α-keto-β-methylvaleric acids formed by enzymatic action from the four isomers of *iso*leucine are given in the accompanying table; within experimental error, the values are in good agreement.

ENZYMATIC FORMATION OF α-KETO-β-METHYLVALERIC ACIDS FROM FOUR ISOMERS OF *iso*LEUCINE

Substrate	Enzyme	$[\alpha]_D^{25}$ of resulting keto-acid hydrazone*
D-*iso*Leucine	D-Amino-acid oxidase†	− 16·7°
L-*iso*Leucine	L-Amino-acid oxidase‡	+ 17·3°
L-*iso*Leucine + α-ketoglutarate	Transaminase§	+ 16·7°
D-allo*iso*Leucine	D-Amino-acid oxidase	+ 16·7°
L-allo*iso*Leucine	L-Amino-acid oxidase	− 17·1°
L-allo*iso*Leucine + α-ketoglutarate	Transaminase	− 16·4°

* Specific rotation of the 2,4-dinitrophenylhydrazone of α-keto-β-methylvaleric acid (2 per cent solution in ethanol; 2 dm. tube).
† Hog's kidney acetone powder extract.
‡ *Crotalus adamanteus* venom.
§ Prepared from hog's heart.

These results demonstrate that the optical configuration about the β-carbon atom of the four isomers of *iso*leucine is maintained during enzymatic oxidation and transamination, and that a reversible α-β-unsaturation leading to loss of asymmetry at the β-carbon does not occur. However, the possibility is not excluded that reversible α-β-unsaturation may be enzymatically directed so as to preserve the configuration of the β-carbon atom.

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Transmission of Natural and Synthetic Mica in the Ultra-Violet

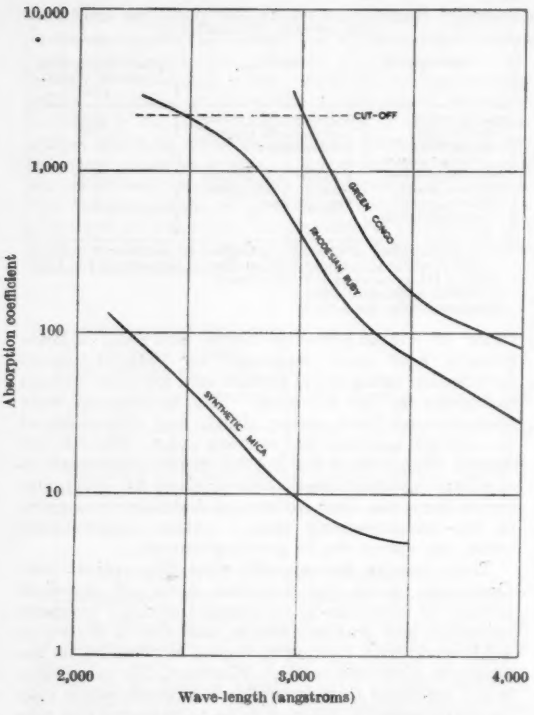
THE various minerals belonging to the mica group are all characterized by the ease with which they cleave. The reason for this behaviour is found in their structure, which consists in all cases of a double sheet of linked silicon – oxygen tetrahedra of the hexagonal type (Si_4O_{10})[1]. One in every four silicon ions is replaced by aluminium in most of the natural occurring micas (phlogopite, muscovite, biotite), thus giving the basic $AlSi_3O_{10}$ units; these are firmly bound by the incorporation of aluminium, magnesium and iron ions and hydroxyl groups. The double sheets are weakly linked by potassium ions, and it is along this plane that cleavage takes place. The most important micas conform to the idealized formulæ:

Muscovite $KAl_2(AlSi_3O_{10})(OH)_2$
Phlogopite $KMg_3(AlSi_3O_{10})(OH)_2$,

but a multitude of substitutions can take place; for example, the magnesium can to some extent be replaced by iron, which gives biotite:

$K(MgFe)_3(AlSi_3O_{10})(OH)_2$.

Attempts to synthetize mica were first made more than fifty years ago, but it has been difficult to grow



large crystals. The best results to date appear to have been achieved with synthetic phlogopite, where the hydroxyl group has been replaced by fluorine, that is, $KMg_3AlSi_3O_{10}F_2$ [2].

Little information is available on the transmission of natural mica in the ultra-violet[3]. Hausman and Krumpell state that the limit of transmission is 2900 A. and that the green variety absorbs highly, ruby mica least. Transmission measurements have been carried out in this Laboratory on a number of samples of natural micas of different origin, all of which had a very high transmission in the visible region, and also on a water-clear sample of fluorine phlogopite, kindly lent to us by Dr. Middel. The absorption coefficient μ ($I/I_0 = \exp - \mu l$, where I_0 is incident beam, I is transmitted beam, l is thickness in cm.) is shown in the accompanying graph for samples of green Congo, Rhodesian ruby and synthetic mica; due allowance has been made for reflexion losses. These measurements show that the absorption of synthetic mica is much less than that of the natural mica available. This may possibly be ascribed to the low iron content (less than 0·05 per cent) of the synthetic mica we investigated, and, in fact, analysis of the iron content of the samples of natural mica confirmed that the absorption coefficient at 3000 A. was approximately proportional to the iron content. This difference in iron content would also account for the higher ultra-violet absorption of the green variety.

Mica sheets of 10–20 microns thickness are strong enough to be used for windows in vacuum tubes, and vacuum-tight seals both to glass and chrome-iron metal can be made by a simple method[4].

The horizontal line drawn in the graph shows the short-wave cut-off based on a thickness of 10 microns and 10 per cent transmission; for Rhodesian ruby and green Congo mica the limits are respectively 2500 A. and 3000 A. Synthetic mica transmits well below 2000 A.

Synthetic mica can be used, therefore, as a window material with high ultra-violet transmission for vacuum devices such as photocells, electron multipliers, Geiger–Müller counters, thermopiles, etc. Devices with such windows can be used or processed at very high temperatures, since the synthetic mica will stand temperatures greater than 1,000° C. without deterioration, compared with the temperature limitation of muscovite at about 500° C. and phlogopite at 800° C.

I wish to thank Mr. J. A. M. van Moll and the Directors of Philips Electrical, Ltd., for permission to publish this communication.

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Standing Waves in Low-Energy Electron Beams

In some work here on the focusing of rotationally symmetrical electron beams in the energy-range 20–70 volts, we have come across cases of standing-wave patterns in the electron emission from the cathode which may be of interest to valve designers and others working on the properties of low-energy electron beams.

In the case of 'normal' beam formation, the electron distribution over the cross-section as revealed by a scanned slit arrangement is usually a smooth curve having a peak current density on the axis, and falling continuously with distance from the axis all the way to the periphery of the beam. It generally has a Gaussian form.

At low energies, however, there are marked changes. Here, the current to a series of concentric collectors placed transversely at some fixed distance from the emitter, while showing a smooth curve over the cross-section, has a core which appears to approximate to Gaussian form, whereas the tail exhibits a more or less uniform distribution over a considerable portion of its length.

The simple space-charge theory determined by the constancy of the space-charge factor ($V^{3/4}/I^{1/2}$) is found to break down under the following conditions: (*a*) energies less than 20 volts; or (*b*) high emission densities. Both these are connected with effects in the 'virtual' cathode, for example, potential depression. There appears to be an optimum cathode temperature which controls the emission density for both 'semi-hollow' and 'hollow' beams, that is, for those in which the axial emission is less than that off the axis, and where it is practically zero, respectively. The conditions in the 'virtual' cathode are significantly changed by alteration in temperature, which alters emission density, emitting area and initial electron velocity. Fig. 1 shows how the current in the

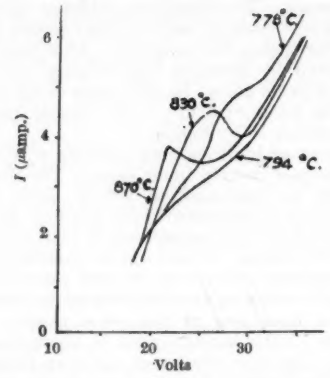

Fig. 1

peripheral region of the beam varies with energy at different temperatures. The total emission characteristic also contained small portions of reverse slope between 20 and 30 volts, which were detected by consecutive measurements at voltages very close together—and were repeatable. The remarkable changes of slope in the 20–30-volt region appear to be connected with changes of state in the cathode emission for particular fields, or to corresponding changes in charge density in the virtual cathode. In fact, the explanation for this kind of anomalous behaviour is much on the same lines as that given by Klemperer[1] from his observations on the splitting of high-energy electron pencils into 'elementaries'. These he attributed to standing-wave patterns in the space charge near the cathode. He quotes C. S. Bull for the suggestion that oscillations set up in the space charge might react on the cathode emission by producing regions of high and low intensity over the emitting surface, and, in fact, this is found to be so on a simple interpretation of the distribution patterns shown in Fig. 2, for a series of energies from 18 to 24 volts. At a higher accelerating voltage ($V = 30$) the current density falls away smoothly from a maximum on the axis.

The periodic character of the fluctuations in emission over the surface is consistent with the assumption that standing waves are present in the space charge. Their formation depends critically on changes in energy over a limited energy-range of about 10 volts. Inside this range, the conditions which make the centre of the cathode either a node or an antinode are extremely sensitive to energy variations—a difference of 2 volts is sufficient to change from one type to the other, as is clear from the graph. The wave-length appears to be of the order of 0·1 mm.

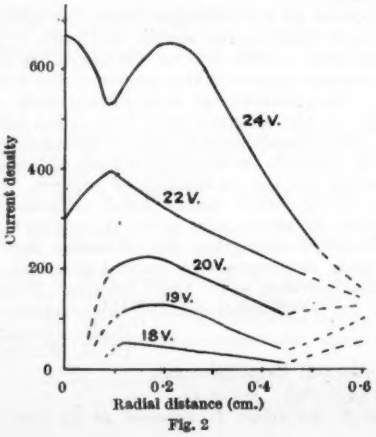

Fig. 2

It is interesting to record that one of us (L. J.) found a similar 'abstraction' of current in a high-energy beam (2 kV.), produced by a conventional electron gun, when certain field conditions were introduced.

It is hoped to publish fuller details of this work in due course.

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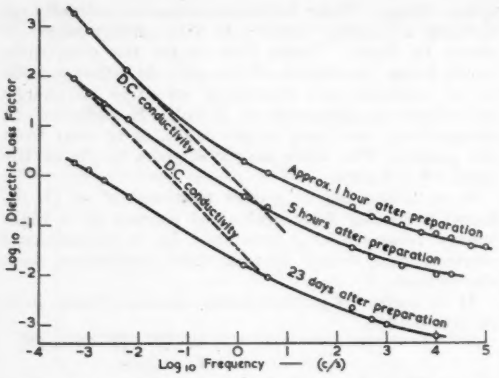
[1] *Proc. Roy. Soc.*, A, **190**, 376 (1947).

Low-Frequency Dielectric Absorption and Direct-Current Conductivity in Quinol

The large dielectric absorption at low frequencies recently observed[1] in crystalline long-chain alcohols has been shown to be probably due to a hydrogen bonding of the hydroxyl groups to form chains. Hydrogen-bonded hydroxyl groups are also present in the dihydric phenol quinol, according to a structure proposed from X-ray crystallographic data[2], but in this case the hydrogen bonds form regular hexagons. With such a structure the resultant dipole moment should be zero and the compound should give no dielectric absorption. However, in recent measurements in this laboratory, considerable low-frequency absorption was observed in three samples of quinol crystallized from water, ethanol and methanol respectively. This absorption decreased with time of storage at room temperature, as shown in the graph (p. 1122) of the results for the sample crystallized from water. The curves are similar in shape to those obtained previously for *n*-hexadecyl alcohol[3], in which the dielectric absorption was attributed to the presence of extensive hydrogen-bond chains, and it seems likely that the results for quinol can be similarly explained.

Measurements with samples prepared at different intervals from the same batch of crystals gave results similar to those shown in the diagram. This suggested that the absorption may not have been present originally in the crystalline quinol, but resulted from the preparation of the sample for measurement. In this process the crystals were ground to a fine powder and then pressed at about 10,000 lb. per sq. in. to form disks. Experiments on the effect of re-grinding and re-pressing aged disks indicated that it was the grinding process which led to the dielectric absorption.

To explain these results, it is suggested that the grinding causes a partial breakdown of the crystal structure followed by a rearrangement in which hydrogen-bond chains are formed. These give rise to the large dielectric absorption. Also this hydrogen-bond chain structure is unstable in quinol and in time reverts to the hexagon formations of the original crystal, with a consequent decrease in the dielectric absorption.



Dielectric absorption at 20° C. in quinol crystallized from water

Evidence that structural breakdown of quinol does occur on grinding was obtained by previous workers[4], who found that sulphur dioxide trapped in the quinol crystal lattice is partially liberated by grinding.

The large dielectric absorption of quinol crystallized from water was accompanied by appreciable direct-current conductivity. This was also observed in the samples obtained from ethanol and methanol respectively. Quinol crystallized from methanol gave an initial conductivity about 5,000 times larger than that of the other samples. This may be related to its different structure and composition[3]. It is less compact, and its crystal lattice contains entrapped methanol molecules which would escape on grinding and possibly take part in hydrogen-bond chain formation. High direct current conductivity has been reported by previous workers with other hydrogen-bonded structures, and is considered to be due to combined proton transition and dipole rotation[5].

The sample disks were measured between mercury electrodes. Bridge methods were used at frequencies greater than 1 c./s. At lower frequencies the dielectric loss factor was calculated from the anomalous charging current measured at different times after the application of a D.C. potential[6].

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Australia. July 12.

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Spectra of Flames burning with Oxides of Nitrogen

We have taken spectrograms of pre-mixed gas flames of hydrogen, ammonia, carbon monoxide and hydrocarbons burning with nitrous oxide, nitric oxide and nitrogen dioxide, respectively. The overall spectra of the hydrocarbon flames are very similar. CH-, CN-, NH- and OH-bands are present, and so also are the C_2-bands. The latter are quite strong in many flames (especially acetylene), but are generally weaker than the C_2-bands in hydrocarbon–oxygen flames. We found no evidence of the CO-fourth positive bands in any of these flames, however strongly our plates were exposed. This band system was reported by Behrens and Rössler[1] in a benzene – nitric oxide flame. In the region of the spectrum where this band system of CO should occur, we obtained strong NO-γ-bands.

The flames of hydrocarbons burning with nitrogen dioxide have a double inner cone. The first inner cone emits a continuum of yellow light, and the second, which is separated from the first by a dark space, emits blue light containing C_2-, CH-, CN-, NH-, OH- and NO-bands. In absorption spectra, the NO_2-bands disappear in front of the first inner cone, and if benzene is taken as the fuel, the ultra-violet bands of benzene disappear at the same position as the NO_2-bands. NO-γ-bands appear in absorption in the first inner cone and disappear again in front of the second inner cone. There is no doubt that both nitrogen dioxide and benzene decompose in the first inner cone. Some interaction between them also occurs, as it is possible to adjust the flame in such a way that the second inner cone blows off and the first cone burns alone, though with diminished flame velocity. Under these conditions a large amount of nitric oxide can be detected in absorption in the exhaust gases. This is normally consumed in the second inner cone.

The hydrogen – nitrogen dioxide flame has only one inner cone, and burns more rapidly than a saturated hydrocarbon flame with nitrogen dioxide. It seems that the nitrogen dioxide readily decomposes in the flame, and that the subsequent reaction of hydrogen and oxygen is sufficient to account for the high flame velocity. Nitric oxide does not seem to participate in the reaction, and consequently the flame does not reach its theoretical temperature. This is confirmed by various observations; for example, the OH-emission from the inter-conal gas is only about one-hundredth of that of a hydrogen/oxygen flame.

The hydrogen – nitric oxide flame has a very low speed, although it has a higher temperature than the hydrogen – oxygen flame, which is very fast. Thermal decomposition of nitric oxide is probably the rate-determining process. This decomposition is very slow and will only take place at very high temperatures. The process is feasible in the hydrogen – nitric oxide flame because the velocity is low and sufficient time is available.

In contrast to the hydrogen flame, the ammonia – nitric oxide flame burns readily and with a greatly increased flame speed. Strong NH-bands are emitted which scarcely appear in the spectra of the hydrogen flame. The presence of this radical may be responsible for the different behaviour of the ammonia flame. NH-radicals may be able to decompose nitric oxide and provide an alternative path of low activation energy for the production of oxygen. Hydrocarbon – nitric oxide flames have velocities which increase in the same order as the increasing C_2-, CH- and NH-band strengths, and it seems that nitric oxide again decomposes by radical reactions.

We are indebted to the Chief Scientist, Ministry of Supply, for permission to publish this communication.

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Royal Aircraft Establishment,
Farnborough. June 29.

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A New Method for Measuring the Atomic Heats of Gases

In a previous communication in *Nature*[1], a method was described by which the atomic heats of various gases could be determined from the aspects of heat transfer through the gas. The method has recently been modified to take into account the dependence of the accommodation coefficient upon the pressure of the gas at very low pressures.

In the absence of convection, the rate of heat loss Q corrected for radiation from a uniformly heated thin platinum wire lying along the axis of a cylindrical tube can be represented in terms of the gas pressure P by an equation due to Knudsen and others in the form :

$$Q = 2\pi r_1 LP\,(R/2\pi MT_2)^{1/2}(\beta + \tfrac{1}{2})\alpha_P(T_1 - T_2), \quad (1)$$

in which the mean collision path is greater than, or comparable with, the distance between the wire and the internal surface of the tube. In (1), βR represents the molecular heat of the gas, α_P the coefficient of accommodation, T_1 and T_2 the temperatures of the wire and tube surfaces respectively, r_1 the radius and L the length of the wire, and M the molecular weight of the gas.

Values of α_P calculated from (1) at very low pressures are found to vary considerably with the pressure up to the region in which the temperature-drop effect operates and throughout which the values of α_P are independent of the gas pressure. In this latter range of pressures the modified Fourier's relation is represented[2] by :

$$\frac{1}{Q} = \frac{\log (r_2/r_1)}{2\pi r_1 KL\theta} + \frac{1}{P\theta A}\left(\frac{T_1^{1/2}}{r_1} + \frac{T_2^{1/2}}{r_2}\right), \quad (2)$$

where the term A is defined by :

$$A = \frac{R^{1/2}2\pi\,(\beta + \tfrac{1}{2})2\alpha L}{(2\pi M)^{1/2}(2 - \alpha)}.$$

If the temperature of the wire is kept constant over both ranges of pressures, and if α_P is known as a function of pressure and temperature, β can be calculated. Equation (1) must be modified, using the Langmuir adsorption equation :

$$\theta/N_0 = bP/(1 + bP),$$

where θ denotes the number of lattice spaces per square centimetre of the wire surface which are occupied by gas molecules at a pressure P and temperature T, and N_0 denotes the total number of lattice spaces per square centimetre. The effect of accommodation may be considered as being due to the extent to which the lattice spaces are occupied by molecules. Hence we may write for α_P, following Amdur[3],

$$\alpha_P/\alpha_\infty = \theta/N_0 = bP/(1 + bP), \quad (3)$$

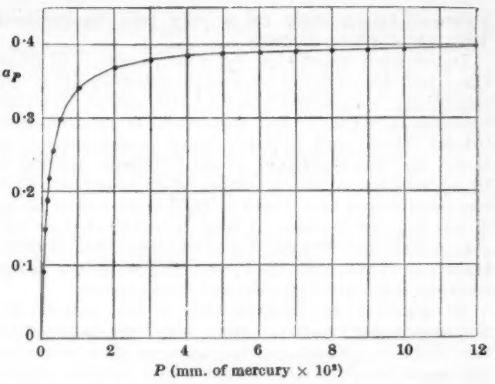
where b is a function of temperature and α_∞ denotes the coefficient of accommodation over the temperature-drop range of pressure.

Equation (1) may now be written in the form :

$$\frac{P^2}{Q} = \frac{1}{2\pi r_1 L(R/2\pi MT_2)^{1/2}(\beta+\frac{1}{2})\alpha_\infty(T_1-T_2)}\cdot\left(\frac{1}{b} + P\right),$$

from which P^2/Q is found to satisfy a linear relation with P. At the same time, $1/Q$ has been found to satisfy a linear relation with $1/P$ over the temperature-drop range of pressure at the same wire temperature as in (1).

It is therefore possible to determine β and α_∞ and also a value of b. The accompanying graph shows



the variation of α_P with P as quoted from equation (3) by the substitution of α_∞ and b for hydrogen at a wire temperature of 19° C. From the graph it appears that α_P rises very sharply with P at very low pressures. The table shows observed values of α_∞ and β for a number of gases at laboratory temperatures.

Gas	H_2	N_2	O_2	He	Ne	A
β	2·49	2·50	2·49	1·49	1·49	1·50
α_∞	0·40	0·81	0·80	0·42	0·78	0·84

The method has also recently been applied in order to investigate the decrease of the rotational energy of hydrogen, oxygen and nitrogen at very low temperatures.

It is hoped to publish a detailed account later.

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Quantitative Paper Chromatography

Fisher, Parsons and Morrison[1], discussing quantitative paper chromatography, found an interesting relationship between spot-length or spot-area and the logarithm of spot content for certain amino-acids and the sugars xylose and arabinose. They suggest that the relationship may be of general applicability to sugars.

Using Longenecker's method[2] for ascending chromatography (somewhat modified), with 500-ml. and 1-litre jars and papers 5 mm. wide, measuring spot-length instead of spot-area, an attempt has been made to confirm this work using saturated *n*-butanol–water mixture (water-poor phase) as solvent and sucrose as the sugar. Spraying was carried out with the phloroglucinol reagent mentioned by Horrocks in his paper[3]. Spot-length instead of spot-area was chosen for measurement because maximum elongation can fairly easily be measured with practice on narrow papers, and the work was intended for rapid assessment of quantitative differences. Sucrose was chosen in preference to xylose or arabinose for investigation, because it is of more interest in studying the nutritional requirements of plants and gives a clear

yellowish-brown stain on a very pale background with phloroglucinol spray.

It has been found that for a spot-content of more than 100–250 μgm. of sucrose (depending upon the conditions mentioned later), the linear relation between spot-length and logarithm of spot-content breaks down, and a much truer representation is found by the logarithm of spot-content bearing a linear relation to the *logarithm* of spot-length. This has been tested and found to hold true over a range 4–450 μgm. of sucrose. It may be noted that at low concentrations of sugar, either the logarithm of spot-length or spot-length itself will tend to give a linear relation with the logarithm of spot-content.

In addition, an investigation of the factors determining the length of stain has been attempted, and there are indications that increase of temperature decreases absolute stain-length while increase in the time of running of the chromatogram has the opposite effect. Increase of the time allowed for equilibrium to be reached before running the chromatogram also increases absolute stain-length. For all the combinations of controlled temperature (35–40° C.), length of run, and time of equilibrium so far tested, the graphs of logarithm of stain-length against logarithm of spot-content have been parallel within the limits of experimental error. On the subject of slow attainment of equilibrium conditions, the recent paper of Müller and Clegg[4] can be consulted.

This work has been carried out as part of the programme in plant physiology of this Section. It is intended to publish a fuller account elsewhere.

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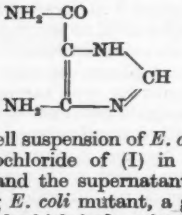
Ribosidation of 4-Amino-imidazole-5-carboxamide by *Escherichia coli*

It has already been shown[1,2] that 4-amino-imidazole-5-carboxamide (I) is a precursor of the purines in *E. coli*; a purine-requiring mutant of the organism grows in a medium containing this substance. On the other hand, it has been observed[3,4] that synthetic 4-amino-imidazole-5-carboxamide is little utilized by a growing culture of *E. coli*. The following observations will eliminate this apparent discrepancy.



(I)

(1) When a cell suspension of *E. coli B* is incubated with the hydrochloride of (I) in *M*/15 phosphate buffer (*p*H 7), and the supernatant is added to the purine-requiring *E. coli* mutant, a growth-enhancing effect is observed which is five times as great as that of the hydrochloride of (I).

(2) The supernatant containing the new factor was lyophilized and the concentrate subjected to paper chromatography according to Carter[5] in 5 per cent potassium dihydrogen phosphate – *iso*amyl alcohol and developed by diazotization. Incidentally, the presence of the original amino group in the new factor was thus established. While the hydrochloride of (I) has R_F 0·68, a new spot of R_F 0·63 was observed. The activity of the new spot was established by the bio-autographic technique of Winsten and Eigen[6].

(3) The fraction containing the new substance showed a positive orcin test and a colour reaction with diphenylamine[7] which exceeded that of the blank, indicating the presence of deoxyribose. The ultra-violet spectrum showed a shifted absorption maximum (2600 A.) as compared with the hydrochloride of (I) (2680 A.).

It seems thus established that 4-amino-imidazole-5-carboxamide is converted by *E. coli* into a glycoside.

(4) It has not been finally established whether the new substance is a nucleoside or a nucleotide. According to Carter[5], nucleotides cannot be chromatographed by means of butanol. Since the new spot could also be obtained in butanol, it seems likely that the new substance is a nucleoside (deoxyriboside of (I)). A similar substance may have been encountered by Friedman and Gots[8] in their recently reported experiments.

(5) In connexion with the mechanism of the conversion of (I) into purine bases, the following observation appears to be of interest. When (I) is added to a cell suspension of *E. coli* in phosphate buffer (*p*H 7) containing 0·2 per cent glucose, the diazotizable amino group disappears, and a substance is formed which has the activity of a nucleoside (it is eight times as active a growth factor for the purine-mutant as the hydrochloride of (I)). It appears that the catabolism of glucose can supply to the glycoside of (I) the C_2 atom of the purine system[3,9].

The question has often been asked[10] whether (I) is utilized as such or in the form of a glycoside. From the observation made here, and those reported recently by Greenberg[11] and by Schulman and Buchanan[12] for pigeon's liver preparations, it seems that the purine bases are formed via their ribosides and ribotides, and that in (I) the pyrimidine ring is closed only after ribosidation has occurred. According to S. E. Kerr *et al.*[13], however, adenine and guanine are incorporated by rapidly growing yeast into ribonucleic acid much *better* than the corresponding nucleosides and nucleotides.

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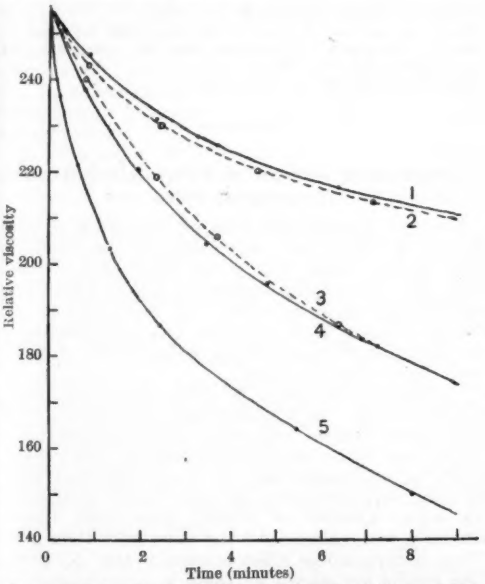
Effect of Histamine on the Activity of Hyaluronidase

M. Fabinyi and J. Szebehelyi[1] have reported that histamine neutralizes the inhibition of hyaluronidase with heparin. We had already dealt with the problem of the influence of histamine on the system hyaluronic acid – hyaluronidase – hyaluronidase-inhibiting agents. Since we had not observed any effect of histamine at that time, we decided to repeat our investigations. Unfortunately, the communication by Fabinyi and Szebehelyi gives no information as to the source of their hyaluronic acid and hyaluronidase, or the concentrations used in their investigations; and we have received no reply to a request for further information.

In our latest investigations we used as substrate highly purified hyaluronic acid (from umbilical cords) as well as a fresh, watery extract from umbilical cords. A hyaluronidase preparation by Armour Laboratories, Chicago, and a testicular extract from guinea pigs were used as enzymes. As inhibitory agents we used partly heparin (Hoffmann–La Roche, Basle) and partly fresh human serum. Viscosity measurements were carried out with a viscosimeter of the Ostwald type at a temperature of 37° C. McIlvain's citrate buffer, together with sodium chloride, *p*H 7·0, were used as solvents. The concentrations of heparin and serum were chosen with the view of producing a distinct, but not complete, inhibition of the hyaluronidase.

We find that the time-curves for the reduction of hyaluronic acid in the presence of heparin and histamine (the latter up to 20 mgm. per cent) coincide with the control without histamine. Histamine *in vitro* has therefore no marked influence on the system hyaluronic acid – hyaluronidase – heparin.

According to Swyer[2], there is also *in vivo* merely an additional effect but no reciprocal action between hyaluronidase and histamine.



Decrease of viscosity of a solution of hyaluronic acid by means of hyaluronidase. Curve 1, with heparin (8·5 mgm. per cent); curve 2, with heparin (8·5 mgm. per cent) and histamine (14·7 mgm. per cent); curve 3, with heparin (2·1 mgm. per cent) and histamine (14·7 mgm. per cent); curve 4, with heparin (2·1 mgm. per cent); curve 5, without heparin and histamine

We conclude that Fabinyi and Szebehelyi's view that histamine causes an enzymatic depolymerization of tissue mucoids by favouring the action of the hyaluronidase, inhibited by heparin, is untenable.

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Response of the Isolated Rat Diaphragm to Repeated Stimulation

Gans and Miley[1] showed that skeletal muscle of the adrenalectomized animal is easily fatigued *in situ*. Ingle[2] used this property of the adrenalectomized rat as a basis for the assay of cortical hormones, and he has more recently shown[3] that cortisone also increases its resistance to fatigue. Schweitzer[4] attributed this readiness to fatigue to a fall in blood pressure due to the loss of the adrenals. The fatigue has also been attributed in part to impaired neuromuscular transmission[5], but Walker[6] opposes this view.

The response of the isolated rat diaphragm to frequent stimulation through the phrenic nerve, and the effect of cortisone and of deoxycorticosterone acetate on this response have been investigated. Normal and salt-treated adrenalectomized rats of about 150 gm. were used.

Phrenic nerve-diaphragm preparations, suspended in Krebs's solution (with 5 mgm. calcium ions per 100 ml.) at 38° C. through which a gas mixture of 95 per cent oxygen and 5 per cent carbon dioxide was bubbled, were stimulated through the nerve to give a maximal response with a current duration of 200 μsec. at a frequency of 12/min. After a steady height of contraction had been reached (1–2 hr.), the rate of stimulation was increased to 2/sec. for 5 min., and then restored to 12/min.

In the preparation from normal rats, the twitch tension immediately after the 'fatiguing' stimuli was usually about 68 per cent of what it was immediately before. Experiments carried out throughout the day at intervals gave similar results. After a period of rapid stimulation, the twitch tension never recovered its original height unless the fluid in the bath was replaced; even then recovery was usually incomplete. Similar preparations from adrenalectomized animals gave similar results (see table; cf. Ramey *et al.*[7]).

The effect of adding cortisone or of deoxycorticosterone acetate to the bath fluid was tried. Four separate experiments, as described above, were carried out on each preparation, the periods of rapid stimulation (2/sec.) being separated by an interval of 1 hr. The bath fluid was changed after each experiment.

Per cent Decrease in Twitch Tension due to Rapid Stimulation (2/sec. for 5 min.)

	Exp. 1 control	Exp. 2 with drug	Exp. 3 control	Exp. 4 with drug
Normal	32	34 *C*	31	44 *C*
Adrenalectomized	35	35 *C*	37	34 *C*
Normal	26	24 *D*	14	25 *D*
Adrenalectomized	35	38 *D*	31	29 *D*

C = Cortisone. *D* = Deoxycorticosterone acetate

About 30 min. before the second and fourth experiments, the drug to be tested was introduced into the organ bath. The solutions of cortisone and of deoxycorticosterone acetate were prepared by diluting the proprietary preparations (Merck and Co., and Dale respectively) with 20 per cent alcohol, so that 1 ml. contained 500 and 100 μgm. of the drug respectively. The volume of fluid in the bath was 55 ml. 1 ml. of 20 per cent alcohol had no effect on the twitch tension. The results show that the drugs did not influence the 'fatigue' process.

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Protective Action of Methylamine against X-Irradiation

Colter and Quastel[1] have shown that many amines (benzedrine, ephedrine, tyramine, methylamine, dimethylamine, ethanolamine and histamine) act as competitive anticholine oxidases, and protect choline oxidase against the inactivating effect of nitrogen mustard. It is well known that irradiation with X-rays has many effects in common with mustards. Accordingly, we tried the least toxic of these amines as protector in mice against a lethal dose of X-rays.

Mice of pure breed (*C* 57 black), four to six months old, were exposed to X-rays in groups of ten, in a cardboard box 10 cm. × 10 cm. Physical constants: 250 kV., 18 mA., copper filter 0·25 mm., focal distance 50 cm., field 150 cm.², mean output 90 r./minute.

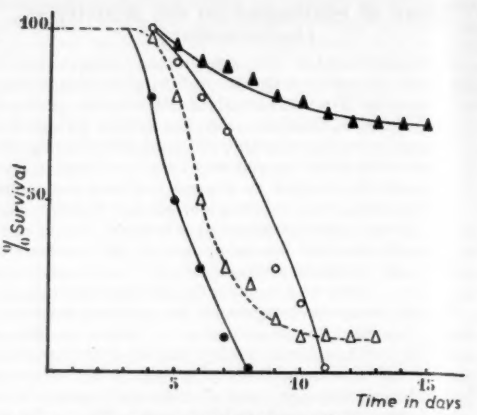
A first control group of mice received a single lethal dose of X-rays. A second group was injected intraperitoneally with methylamine (2 mgm.) neutralized in water solution; this dose is well tolerated. A third group was irradiated just as the controls, immediately after an intraperitoneal injection of 2 mgm. methylamine.

Forty controls received either 700 r. or 850 r. All the mice irradiated with 700 r. died between the fifth and the tenth day after irradiation; those which had received 850 r. died between the fourth and the eighth day.

In the group of fifty animals injected and irradiated with 700 r., the mortality (from the fifth to the twelfth day) was small; 73 per cent of the animals survived (see graph).

The mice injected with methylamine and irradiated with 850 r. died between the fourth and eleventh day, later generally than the controls; only 7 per cent survived. An injection of 2 mgm. or 2·5 mgm. of methylamine did not protect any animal against a dose of X-rays greater than 850 r. A dose of 2 mgm. methylamine injected 5 or 15 min. after the end of the irradiation (700 r.) shifted the mortality curve slightly to the right.

Thus, just as it has been shown with sodium cyanide and sodium azide[2,3], the action of methylamine is one of pure protection: the substance must



○, 700 r.; ▲, 2 mgm. methylamine and 700 r.; ●, 850 r.; △, 2 mgm. methylamine and 850 r.

be present in the body during the irradiation; it becomes ineffective if given after irradiation.

Our observations offer a new fact in favour of the similarity of action of mustards and X-rays, which has been emphasized recently (for a review, see Bacq[4]).

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Protective Action of Ethyl Alcohol on Irradiated Mice

Earlier unpublished work on the effects of ethyl alcohol on cells *in vitro* suggested to us the possibility that alcohol might modify the response to X-rays. With the present-day interest in agents which may modify the systemic effects of radiation, it was thought worth while to carry out experiments on the influence of alcohol on the lethal effects of whole-body irradiation in mice.

Pure-bred mice of the "A" strain six to eight weeks old were used. In a preliminary experiment, ethyl alcohol was diluted with saline to a concentration of 10 per cent by volume and the solution administered orally in two doses each of 1 ml., the first given 80 min., and the second 20 min., before irradiation. An equal number of control mice were treated similarly with saline. All the mice were then given 700 r. X-rays, a dose which is lethal to the "A" strain. The results are shown in Table 1.

Table 1

Treatment	Number dead	% Mortality
Saline followed by 700 r.	22/22	100
Alcohol followed by 700 r.	14/22	63

More extensive experiments were then carried out, using as a criterion the difference in L.D.50 determined by the probit method for control and alcohol-treated mice. For this determination four or five dose-levels were chosen which could be presumed to bracket the 50 per cent lethal dose for this strain of mice. One group of alcohol-treated and one group of control mice were irradiated at each dose-level.

The figures obtained in one experiment are shown in Table 2; they demonstrate a rise in the L.D.50 dose with alcohol treatment (1·5 ml. 10 per cent alcohol, given as two doses before irradiation).

Table 2

	Number of mice	L.D.50	Stand. dev. of L.D.50
Alcohol	110	625 r.	13·3 r.
Saline	109	554 r.	8·7 r.

The difference here is highly significant ($p > 10^{-4}$).

The protective effect of alcohol was also examined from the point of view of the lengthening of the time of survival of mice which die within the time-span of the experiment (thirty days).

It has been found from other experiments that at doses at and above the L.D.100 level the mean survival-time of mice decreases inversely with dose. The mean survival-time was calculated for two experiments. In one, mice were irradiated with 690 r., in the second with 700 r. In the first experiment the mean survival-time for saline-treated controls was 10·0 days, that for alcohol-treated animals being 12·5 days. In the second experiment the figure for controls was 9·0 days, compared with 12·1 days for alcohol-treated mice. The difference in both cases is significant ($p = 0·05$).

It would therefore seem that the administration of alcohol prior to radiation increased the dose required to kill 50 per cent of the mice, and extended the life of non-survivors.

No protection was obtained when the 10 per cent alcohol solution was given after radiation in two doses, 1 ml. immediately after radiation followed by 0·5 ml. one hour thereafter.

Comparison of the protective effects of equal volumes of 10 per cent or 5 per cent alcohol showed that both concentrations were protective, but that the difference in protection value between them was not significant.

In an attempt to compare the protective effect of alcohol with that of cysteine, using the same strain of mice, it was found that an intravenous dose of 20 mgm. cysteine per mouse seemed to have a rather greater effect than oral alcohol in the doses used. We have not tried the effects of higher doses of alcohol.

The protective effect of alcohol is probably unrelated to its anæsthetic effect. Although the majority of mice given 1·5 ml. of 10 per cent alcohol were rendered unconscious, this was rarely the case for mice given the same volume of 5 per cent alcohol.

Furthermore, we have tested two other substances at anæsthetic doses for protection: (*a*) nembutal intravenously, 1·3 mgm. per mouse, (*b*) ethyl carbamate intraperitoneally, 20 mgm. per mouse. Neither of these substances altered the L.D.50. This was rather surprising in the case of ethyl carbamate, as this has been found to lessen the lethal effect of X-rays on cells *in vitro*.

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Microspheres of Organic Substances

SPHERICAL particles of glass ranging in diameter from about one micron upwards, which can be prepared by the method of Bloomquist and Clark[1], have found a wide range of usefulness, for example, as adsorbents of known surface area[2], as material for the study of 'fluidization' of beds of particles[3], and in electrokinetic measurements on cataphoresis and sedimentation velocity[4,5]. For many such experiments, particularly the electrokinetic ones, it would be desirable to be able to use microspheres of substances other than glass. I have found that it is possible to obtain many organic compounds in microspherical form, provided that they melt below 100° C., and are more or less insoluble in water. The substance to be used is mechanically stirred at a very high rate with thirty to forty times its weight of water, at a temperature 10–15° above the melting point of the substance, thus producing an unstable emulsion of liquid drops in water. This is then run rapidly into a large excess of cold water, producing solid spherical particles of the substance. Some degree of control over the size of particle obtained can be exercised by modifying the rate and time of stirring. In this way, microspheres of naphthalene, octadecane, *m*-dinitrobenzene, cetyl alcohol, stearin, stearic acid, and several other organic compounds have been prepared. These particles are used in the study of the electrokinetic properties of organic compounds by the method of electroviscous sedimentation[6].

Most of these particles keep indefinitely under water, but if allowed to dry off, some of the softer ones tend to lose their shape. Some aggregation may also occur on drying, and the particles are then difficult to redisperse, so that it is advisable to store them under water so far as possible.

It should prove feasible to apply this method to low-melting inorganic substances, using non-aqueous liquids as dispersing media.

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An Isopod, *Asellus meridianus* Racovitza, with Low Chromosome Number

IN the past fifty years, several papers have described the chromosomes of Isopoda, and the numbers for twenty-seven species have been recorded. Most of this work has been done by Vandel[1,2]. The numbers range from 6 to 60 taking the group as a whole, but some families may show less variation than others[5]:

Haploid numbers:	6,	7,	8—16,	17—24—27,	28,	29,	30,	31—34—60
Flabellifera	1							
Epicaridea		1						
Asellota		1	3		1			
Oniscoidea			3	1 1 2	2	6	1	1 1 1
Valvifera						1	1	

Vandel[2] has studied two species of *Asellus*, *A. aquaticus* and *A. meridianus*, both with $2n = 16$. According to him, *meridianus* has only *v*-shaped chromosomes and at metaphase I he finds 8 bivalents and a 'chromatoid body'. He further states that his *meridianus* is identical with the species as it was first described by Racovitza[3].

The systematics of Asellota has become very complex in the past thirty years owing to the large number of species and subspecies described (Chappuis[4]). I therefore took great care in identifying the British *Asellus meridianus*; it corresponds in every detail with the original description by Racovitza. The chromosome number of the British *Asellus meridianus* Racovitza, however, is $n = 5$, the lowest number recorded for the Isopoda.

We are then faced with the possibility that a species has morphologically identical forms on the Continent and in England, but the chromosome numbers of which differ specifically. Since it is apparently easier to find racial differences than complete homology in this genus (Chappuis[4]), some mistake has probably been made.

The five chromosomes are median and submedian, ranging in size from 5·5 to 10 μ at mitotic metaphase. In embryonic tissue the chromosomes can be studied in detail. One chromosome pair has a terminal heterochromatic block in the short arm and what appears to be a secondary constriction in the long arm. The constriction is only clear in some cells, but a certain precocity in chromatid separation in the distal part can frequently be seen.

The heterochromatin in the short arm organizes the nucleolus. At telophase two nucleoli are formed which later fuse. Consequently, in prophase the two heterochromatic ends are frequently found in proximity when the nucleolus has disappeared.

It is not possible to detect any differences in chromosome morphology between the embryos, so one must conclude that no distinguishable sex chromosomes are present. One embryo (out of about sixty) was heterozygous for the terminal heterochromatin.

In male meiosis the nucleolus persists at metaphase I in about 10 per cent of the cells. The chiasma frequency appears to be about 1·7 per bivalent at diplotene (twelve cells) and 1·1 at metaphase (twelve cells). Some caution must be exercised with regard to the diplotene frequency because centric pairing (and stickiness) is not uncommon. This is presumably the reason why some chromosomes are seen to have fallen apart before metaphase II. They may also be univalents which divided at first division; but this is not likely since the univalent frequency must be low.

The material is very well suited for experimental work, particularly with water-soluble chemicals. In the early spring (March) the smaller females are found attached underneath the males, a relation which they maintain even when the embryos are well advanced in development. Underneath the female in the brood-pouch, about eighty embryos are found beautifully synchronized in development. This brood-pouch can easily be opened and the embryos reared separately for experimental series. They are easily penetrated by chemicals; for example, a 0·025 per cent colchicine solution gives complete *c*-mitosis after four hours.

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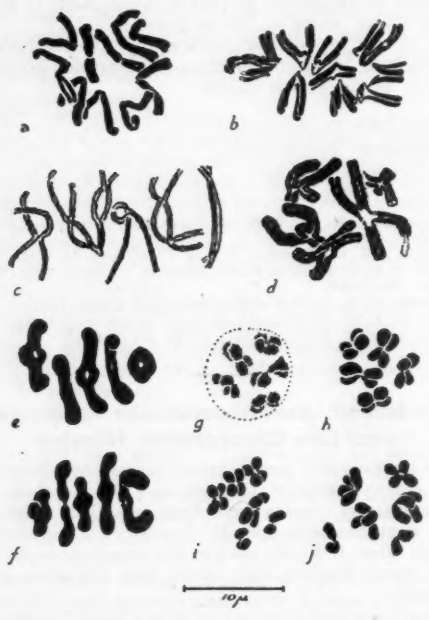

(*a*) Somatic mitosis from embryo; big autosome at 9 o'clock showing split chromatids distally to secondary constriction. (*b*) Early anaphase; homologous chromosomes at 9 and 2 o'clock with secondary constrictions and terminal heterochromatin. (*c*) Diplotene bivalents drawn separately. (*d*) Diakinesis; animal heterozygous for heterochromatin. (*e*) and (*f*) Metaphase I: spermatogenesis. (*g*) Interkinesis. (*h*) Prometaphase II; normal. (*i*) and (*j*). Same; abnormal with one split univalent

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Nature of Ovarian Dermoid Cyst Fat

The fat which accumulates in the ovarian dermoid cyst has long attracted interest. Sotnitchewsky[1], in 1880, suggested that this fat was analogous to sebum, and since that time it has been assumed by many workers that the two substances are identical—an assumption that receives support from the histological evidence of the presence of sebaceous glands in the cyst walls. Many studies of the composition of this fat have been made[2], but these are incomplete and have been concerned largely with the unsaponifiable matter present. During the course of a study of the composition of human sebum[3], a supply of the fat from a dermoid cyst became available, and the opportunity was taken to compare the composition of the cyst fat with that of sebum.

The general properties of the dermoid cyst fat are shown in Table 1, together with the corresponding figures, obtained by MacKenna, Wheatley and Wormall[3], for human sebum. The non-saponifiable matter was fractionated chromatographically, and the results are summarized in Table 2, together with the results of similar studies on human sebum[4]. The separated fractions of the dermoid cyst fat, with the exception

Table 1. General Properties of Ovarian Dermoid Cyst Fat compared with those of Human Sebum

	Dermoid cyst fat	Sebum
Melting point	33·8°	35–37°
Iodine No.	55·6	53–63
Acid No.	0·6	59–73
Cholesterol (total)	3·6 per cent	2·7–5·9 per cent
Total nitrogen	nil	0·42–0·49 "
Lipid phosphorus	nil	nil
Fatty acids (free)	0·6 per cent	22–32 per cent
Fatty acids (combined)	70·2 "	28–41 "
Unsaponifiable matter	27·3 "	27–36 "

of the hydrocarbon fraction, appear to be almost identical with those obtained from human sebum. The hydrocarbon fraction of the cyst fat, however, appeared to consist of practically pure squalene, with only a trace of *n*-paraffins, whereas the corresponding fraction from human sebum contained less than 50 per cent of squalene, the remainder consisting principally of *n*-paraffins, probably mainly of pentacosane.

Table 2. Comparison of the Fractions of the Unsaponifiable Matter of Dermoid Cyst Fat with those of Human Sebum

Fraction	Nature	Dermoid cyst fat (per cent)	Sebum (per cent)
I	Hydrocarbons	13·2	37–46
II	*n*-Alcohols and oxidized squalene	56·3	17–25
III	Cholesterol	11·8	14–19
IV	Unidentified sterol and oxidized squalene	7·8	4–11
V	Unidentified	7·8	6–13

The results obtained show that the dermoid cyst fat differs significantly from human sebum. The free fatty acids, so characteristic of human sebum, are almost completely absent from dermoid cyst fat. Only a trace of *n*-paraffin is present in the cyst fat, but a very much larger amount of *n*-alcohols (principally eicosanol) is present. In general, however, the differences between the two fats are quantitative rather than qualitative, and this suggests that the dermoid cyst fat may be sebum in which the process of formation has not gone to completion.

Further studies of this cyst fat are now being made in an effort to identify completely the constituents of the unsaponifiable matter, in the hope that this information will help the studies of human sebum at present in progress. Fuller details will be published elsewhere when these studies are complete.

I wish to thank Dr. Magnus Haines, of the Chelsea Hospital for Women, for kindly supplying the sample of ovarian dermoid cyst fat, and Dr. R. M. B. MacKenna and Prof. A. Wormall for their interest and help in this work.

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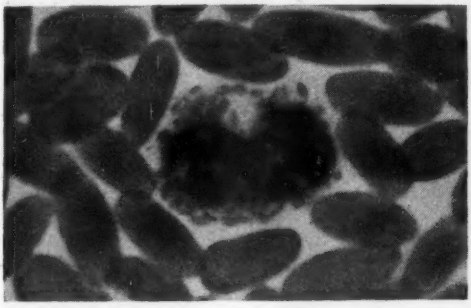
The Eosinophil Cell as seen in the Llama

The increasing clinical use of substances of the cortisone group raises many new questions in the field of hæmatology, and it is considered that observations made in the animal kingdom, particularly in regard to the aspect and behaviour of the eosinophil cell, should help towards a greater understanding of the physiology of this cell in mammals, and therefore in the human being, and perhaps also of the problems arising in therapeutic practice.

Wishing to confirm my observations of the eosinophil cell, as seen in the camel[1], by making further investigations on an animal of the same family, I obtained, with the generous co-operation of the Zoological Gardens, London, some blood slides from the llama. The slides were stained with May–Grunwald–Giemsa, and it was expected that the red blood corpuscles would be elliptical as in the camel. Instead, however, the corpuscles were found to be much more elongated than in the camel, the length varying considerably, some red blood corpuscles being up to twice the length of others. Moreover, the granules of the eosinophil cells were also elongated, some actually appearing to be more like rods.



Peripheral blood from the llama showing the granules of the eosinophil cell, some being very elongated and rod-like. Notice in the background the different sizes of the red blood corpuscles

The llama, therefore, confirms what appears to be a rule in the eosinophils of mammals, namely, that the characteristics of the eosinophil granules bear a definite relationship to the characteristics of the red blood corpuscles in the same mammal, particularly in shape. Cases of ovalocytosis in human beings show this same relationship very clearly. This further confirmation, afforded by investigation of the llama's blood, gives added weight to my interpretation of the physiological function of the eosinophil cell as a precursor of red blood corpuscles. It should be possible to watch the cycle of red blood corpuscle secretion in the spleen of the llama with a series of eosinophil cells showing, in their cytoplasm, the growth of granules to the size of fully developed red blood corpuscles, before being shed into the blood circulation, in the same way as this has been observed in a thyroid hæmorrhagic cyst in human beings, and in the spleen of the camel.

F. Duran-Jorda

Manchester Babies' and Children's Hospital
Management Committee,
Booth Hall Hospital,
Manchester 9.
July 13.

[1] Duran-Jorda, F., *Lancet*, 451 (August 18, 1948); *Nature*, **165**, 280 (1950).

Differentiation of Skeletal Structures from Mouse Embryo Mince in the Peritoneum of Adult Mice

In the course of attempts, as yet unsuccessful, to produce a non-malignant ascites growth of undifferentiated cells in peritoneal exudate, virgin female mice of two genotypes were injected intraperitoneally with homologous embryonic tissue mince, dissociated in a Waring micro-blendor and capable of passage through a 22-gauge hypodermic needle. Embryos ranged from the 4½-mm. 13-day stage, at which condensations of mesenchyme appear at the location of the future skeletal axes, to 8 mm. in length. Each of ten hosts received an inoculum equivalent to three embryos.

Skeletal structures recovered from the peritoneum of mice three weeks after injection with mouse embryo mince. (1) Talus; (2) abnormally regenerating rib; (3) distal portion of 9th or 10th rib; (4) head of humerus; (5) ascending ramus of pubis; (6) bone teratoma

The treated mice failed to produce ascitic fluid, such as obtained by Klein[1] with a representative variety of dissociated neoplasms. Three to five weeks after injection, all the hosts were found to contain various teratomata, islands of bone and cartilage attached to the surfaces of spleen, liver, diaphragm and mesentery, and numerous fully differentiated, anatomically defined bones, including whole ribs, phalanges, sesamoids and vertebræ, corresponding in size to the skeletal proportions of mice about one week after birth. The bony structures (see photograph) are of especial morphogenetic interest, in that they provide further evidence (similar to the *in vitro* results of Fell and Robinson[2] with chick femoral rudiments) that skeletal primordia surpass other tissues in their capacity to attain not only advanced histological differentiation, but also to continue their normal anatomical development in foreign sites. In a relevant experiment, Ephrussi[3] cultured portions of 10-day mouse embryos homozygous for the lethal brachyury gene and their normal sibs and obtained differentiation of cartilage, but no definitive bone. It remains to determine the earliest developmental stage from which anatomically recognizable parts of the skeleton may be grown *in vitro* or *in vivo* and the minimal size of fragment still permitting organized bone growth.

Theodore S. Hauschka
Institute for Cancer Research and
The Lankenau Hospital Research Institute,
Philadelphia, Pa.

[1] Klein, G., *J. Exp. Cell Res.*, **11**, 291 (1951).
[2] Fell, H. B., and Robinson, R., *Biochem. J.*, **23**, 767 (1929).
[3] Ephrussi, B., *J. Exp. Zool.*, **70**, 197 (1935).

Toxicity of Copper in Solution to the Stone-loach

In June 1951, stone-loach (*Nemacheilus barbatulus* L.), which had been kept alive in an aquarium since March 1951, died when it became necessary to replace the water supply, which came from a nearby reservoir with lake-water from Windermere. Chemical analysis showed that the original water contained 0·15 p.p.m. copper (Cu^{++}) whereas the lake-water had 0·28 p.p.m. copper, presumably derived from the inflow pipes. Stone-loach, when placed in water containing copper in solution from nil in steps of 0·05 to 0·30 p.p.m. copper, lived in concentrations less than 0·20 p.p.m. copper, but all except one fish died within twenty-four hours at concentrations of 0·20 p.p.m. and above. It seems reasonably certain, therefore, that the fish died of copper poisoning. This note is published because it may be of practical interest.

F. J. Mackereth
W. J. P. Smyly

Freshwater Biological Association,
Windermere Laboratory,
Ambleside,
Westmorland.
July 31.

An Improved Block for Spore-Formation in Yeast

V. Hartelius and E. Ditlevsen[1] recently directed attention to the fact that gypsum blocks used for spore-formation in yeast will not tolerate the strong heating necessary for adequate sterilization. After trials with various materials, they finally chose a block cast of Portland cement and kieselguhr, which after hardening in carbon dioxide is sufficiently porous.

Nearly sixty years ago, H. Elion[2] referred to the disadvantages of the use of gypsum blocks for the study of spore-formation in yeast. He stated that he had been using for several years small cubes, size 2 cm. × 2 cm. × 2 cm., made to his specifications of unglazed porcelain, and that these blocks, which could be obtained from laboratory supply houses, can easily be cleaned, sterilized and used repeatedly. Elion described the excellent results which he had obtained by using these porcelain blocks in the study of spore-formation in yeast, and during many years thereafter he continued to use these blocks to his great satisfaction.

E. Elion

Technical Representations, Inc.,
Washington, D.C.

[1] Hartelius, V., and Ditlevsen, E., *Nature*, **168**, 385 (1951).
[2] Elion, H., *Cent. Bakt. und Parasit.*, **13**, 749 (1893).

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Tuesday, January 1—Friday, January 4

GEOGRAPHICAL ASSOCIATION (at the London School of Economics, Houghton Street, Aldwych, London, W.C.2).—Annual Conference.

Wednesday, January 2

ASLIB (at the Institute of Physics, 47 Belgrave Square, London S.W.1), at 5.30 p.m.—Dr. H. R. Lang: "Editorial Work".

Thursday, January 3

INSTITUTE OF METALS (at the University, Edgbaston, Birmingham), at 2.30 p.m.—Discussion on "Tool and Die Materials for the Extrusion of Non-Ferrous Metals and Alloys".

Friday, January 4

BRITISH SOCIETY OF RHEOLOGY (in the Physics Lecture Theatre, The Polytechnic, Regent Street, London, W.1), at 10.15 a.m.—Conference on "Abrasion and Wear of Materials".*

BRITISH PAPER AND BOARD MAKERS' ASSOCIATION, TECHNICAL SECTION of the NORTHERN DIVISION (at the Engineers' Club, Albert Square, Manchester), at 7 p.m.—Mr. A. F. Williams: "The Application of Chromatography to the Paper Industry".

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

SCIENTISTS III at the Divisional Laboratory, Ystrad Mynach, and in the No. 6 Area Laboratory, Tredegar—The Divisional Establishment Officer, National Coal Board, South-Western Division, Cambrian Buildings, Mount Stuart Square, Cardiff (January 5).

SENIOR LECTURER or LECTURER IN CHEMICAL PATHOLOGY at the University College of the West Indies—The Secretary, Senate Committee on Higher Education in the Colonies, Senate House, University of London, London, W.C.1 (January 7).

BACTERIOLOGIST (Senior Scientific Officer or Principal Scientific Officer grade) IN THE DEPARTMENT OF MICROBIOLOGY, for work concerned principally with elucidating the nature and role of the micro-organisms of the alimentary tract of animals—The Secretary, Rowett Research Institute, Bucksburn, Aberdeenshire (January).

CHAIR OF THEORETICAL PHYSICS at King's College—The Academic Registrar, University of London, Senate House, London, W.C.1 (January 28).

LECTURER IN THE DEPARTMENT OF VETERINARY PATHOLOGY—The Registrar, The University, Liverpool (January 31).

LECTURER (Grade II) IN CLINICAL PARASITOLOGY in the Veterinary School, and a LECTURER (Grade II) IN VETERINARY SURGERY—The Registrar and Secretary, The University, Bristol (January 31).

MEDICAL GRADUATE (with research experience in biochemistry) AS RESEARCH FELLOW IN CHEMICAL PATHOLOGY in the University of Melbourne—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (January 31).

LECTURERS (2) IN PURE MATHEMATICS—The Secretary, Queen's University, Belfast (March 15).

FOULERTON RESEARCH FELLOWSHIP IN MEDICINE—The Assistant Secretary, Royal Society, Burlington House, Piccadilly, London, W.1 (May 1).

ASSISTANT DIRECTOR (Engineering) at the Atomic Energy Research Establishment, Harwell—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26–28 King Street, London, S.W.1, quoting C.417/51A.

ASSISTANT ENGINEER (Mechanical)—The Clerk, Metropolitan Water Board, New River Head, Rosebery Avenue, London, E.C.1, quoting Ref. (M).

ASSISTANT ENGINEERS (Electrical)—The Clerk, Metropolitan Water Board, New River Head, Rosebery Avenue, London, E.C.1, quoting Ref. (G).

ASSISTANT EXPERIMENTAL OFFICERS by the Meteorological Office, to train in London as Weather Forecasters for services mainly at airfields in the United Kingdom—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26–28 King Street, London, S.W.1, quoting A.260/51A.

ASSISTANT RESEARCH MANAGER (with a first- or second-class honours degree in chemistry, or equivalent qualification; experience in industrial research is essential) in the Research and Development Branch, Windscale Works, Sellafield, Cumberland, to be responsible for a group engaged on applied research, mainly in the field of inorganic and radio-chemistry, but including a section working on problems of organic chemistry—The Ministry of Supply, Division of Atomic Energy (Production), Risley, Warrington, Lancs, quoting Ref. 278.

BIOCHEMIST—The Secretary, Doncaster Hospital Management Committee, Royal Infirmary, Doncaster.

DIVISIONAL STATISTICS SUPERVISOR (preferably with a University degree, or a recognized professional qualification with Statistics as the main subject) in the Durham Division, with headquarters at Newcastle-upon-Tyne—The Divisional Establishments Officer, National Coal Board, Durham Division, 'D' Floor, Milburn House, Newcastle-upon-Tyne 1.

ENGINEER at a Ministry of Supply establishment near Sevenoaks, to solve problems in the design and development of a wide variety of prototype machines and equipment (e.g., large camera equipment, specialized machine tools, moulds and dies for specialized purposes) working to very high precision—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26–28 King Street, London, S.W.1, quoting C.783/51A.

ENGINEERS for Royal Ordnance Factories in Bridgwater, Pembrey, Thorp Arch, Leeds, Chorley, Wigan, Blackburn, Bishopton, Irvine, Glascoed, Swynnerton and London—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26–28 King Street, London, S.W.1, quoting C.726/51A.

EXECUTIVE ENGINEER in the Public Works Department, Sierra Leone—The Director of Recruitment (Colonial Service), Colonial Office, Sanctuary Buildings, Great Smith Street, London, S.W.1, quoting 27322/13.

EXPERIMENTAL OFFICER to assist in research on glasshouse design and climate—The Head of the Garden Research Department, John Innes Horticultural Institution, Bayfordbury, Hertford.

JUNIOR PHYSICIST, for electrical heating research—The Director, Electrical Research Association, 5 Wadsworth Road, Greenford, Middx.

PHYSICISTS and ELECTRICAL ENGINEERS (with a first- or second-class honours degree in physics or electrical engineering, or equivalent qualification, with some experience on aerial problems, radio receivers and small transmitters for airborne or mobile use) (Scientific Officer grade) at an R.A.F. Signals Experimental Establishment in Norfolk—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26–28 King Street, London, S.W.1, quoting A.380/51A.

RESEARCH ASSISTANT for concrete laboratory—Prof. A. L. L. Baker, City and Guilds College, South Kensington, London, S.W.7.

SCIENTIFIC OFFICER (with a first- or second-class honours degree in chemistry, metallurgy or physics, or equivalent qualification, at least three years postgraduate research experience, and a good knowledge of German or Russian) IN THE INFORMATION SECTION at the Atomic Energy Research Establishment, Harwell—The Ministry of Labour and National Service, Technical and Scientific Register (K), Almack House, 26–28 King Street, London, S.W.1, quoting F.897/51A.

SENIOR LECTURER, and a LECTURER or ASSISTANT LECTURER, IN ELECTRICAL ENGINEERING—The Secretary and Registrar, University College, Southampton.

REPORTS and other PUBLICATIONS

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Great Britain and Ireland

Academic Adventures in Bloomsbury. By Thomas Lloyd Humberstone. Pp. 20. (London: Ridgell Trout, 1951.) 2s. 6d. net. [279

Directory and Handbook of the Scientific Instrument Manufacturers Association of Great Britain, Ltd. Pp. 252. (London: Scientific Instrument Manufacturers Association, 1951.) [279

British Internal Combustion Engine Research Association. Eighth Annual Report, 1st April 1950–31st March 1951. Pp. 24. (Slough: British Internal Combustion Engine Research Association, 1951.) [279

Department of Scientific and Industrial Research: Building Research Station. National Building Studies, Research Paper No. 11: A Study of the Voussoir Arch. By Dr. A. J. Sutton Pippard and Letitia Chitty. Pp. vi+52+4 plates. (London: H.M. Stationery Office, 1951.) 2s. 6d. net. [279

Philosophical Transactions of the Royal Society of London. Series A: Mathematical and Physical Sciences. No. 874, Vol. 244: The Stability of Saturn's Rings. By G. R. Goldsbrough. Pp. 18. 4s. No. 875, Vol. 244: On the Cardinal Points in Plane Kinematics. By G. C. Steward. Pp. 19–46. 6s. 6d. (London: Cambridge University Press, 1951.) [279

Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences. No. 628, Vol. 235: The Fructification of *Czekanowskia* and its Allies. By T. M. Harris. Pp. 483–508+plates 18–19. (London: Cambridge University Press 1951.) 8s. 6d. [279

Further Education in Middlesex, Session 1951–52. Pp. 80+8 plates. (London: Middlesex County Council Education Committee, 1951.) [279

The Teaching of Statistics in Schools: a Report of the Council of the Royal Statistical Society. Pp. 12. (London: Royal Statistical Society, 1951.) 1s. (279

Scottish Society for Research in Plant Breeding. Reports (abridged) to the Annual General Meeting, 31st July 1951, by the Board of Directors and the Director of the Scottish Plant Breeding Station. Pp. 36. (Edinburgh: Scottish Society for Research in Plant Breeding, 1951.) [110

Ethylene and Propylene Glycols. By John Rae. Pp. 30. (London: Pharmaceutical Press, 1951.) 2s. 6d. [110

Freshwater Biological Association. Nineteenth Annual Report for the Year ending 31st March 1951. Pp. 68+4 plates. (Ambleside: Freshwater Biological Association, 1951.) 2s. [110

Zoological Illustration. (Bodleian Picture Books, No. 4.) Pp. 8+24 plates. (Oxford: Bodleian Library, 1951.) 2s. 6d. [110

The *Practitioner*. 1000th issue, Special Number on Advances in Treatment 1951. Pp. 305–468+xciv. (London: The *Practitioner*, 1951.) 7s. 6d. [110

Register of Research in the Social Sciences in Progress and in Plan. No. 8: 1950–51, with a Directory of Research Institutions. Editor: Feodora Stone. (Published annually for the National Institute of Economic and Social Research, London.) Pp. 174. (London: Cambridge University Press, 1951.) 15s. [110

British Commonwealth Scientific Official Conference. Special Conference on Fuel Research, London, July 1950: Report of Conference. Pp. 16. (London: H.M. Stationery Office, 1951.) 9d. net. [110

A New Periodic Classification of the Elements. By William Norland. Third version, being Chapter 15 of Outline of a Cellular Atom. Pp. 5. (St. Helens: The Author, Heathway, Crossley Road, 1951.) [110

Library Association. Pamphlet No. 4: The Development and Administration of a Special Library; being an Account of the Library of the National Institute for Research in Dairying, Shinfield, Reading. By C. H. Tomalin. Pp. 36. 5s.; to Members, 3s. 6d. Pamphlet No. 5: Public Libraries in the Colonies. By R. A. Flood. Pp. 45. 5s.; to Members, 3s. 6d. (London: Library Association, 1951.) [210

Interdepartmental Committee on Social and Economic Research. Guides to Official Sources No. 2: Census Reports of Great Britain, 1801–1931. Pp. iv+119. (London: H.M. Stationery Office, 1951.) 3s. 6d. net. [310

Department of Scientific and Industrial Research. Report of the Food Investigation Board, with the Report of the Director of Food Investigation for the Year 1949. Pp. iii+36. (London: H.M. Stationery Office, 1951.) 1s. 6d. net. [310

British Standard 1721: 1951, Portable Fire Extinguishers of the Carbon Tetrachloride Type. Pp. 32. (London: British Standards Institution, 1951.) 4s. net. [310

British Standard 1763: 1951, Flexible Polyvinyl Chloride Film and Sheeting (Unsupported). Pp. 24. (London: British Standards Institution, 1951.) 3s. net. [410

Department of Scientific and Industrial Research. Report of the Water Pollution Research Board with the Report of the Director of Water Pollution Research for the Year 1950. Pp. iii+44. (London: H.M. Stationery Office, 1951.) 1s. 6d. net. [1010

Agricultural Research Council: Soil Survey Research Board. Soil Survey of Great Britain, Report No. 3. Pp. iv+36+3 plates. (London: H.M. Stationery Office, 1951.) 3s. net. [1010

British Standard 1674: 1951, Methods of Mixing and Vulcanizing Rubber Test Compounds. Pp. 14. 2s. net. British Standard 1747: 1951, Deposit Gauges for Atmospheric Pollution. Pp. 19. 2s. 6d. net. British Standard 1776: 1951, Fabrication of Lightweight Articles (other than Rainwear) from Polyvinyl Chloride Sheeting. Pp. 11. 2s. net. (London: British Standards Institution, 1951.) [1010

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Indian Council of Agricultural Research. Bulletin No. 71: San Jose Scale in India. By Dr. Hem Singh Pruthi and Dr. V. Prabhaker Rao. Pp. 48. (Delhi: Manager of Publications, 1951.) 1 rupee; 1s. 6d. [110

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Conseil Permanent International pour l'Exploration de la Mer. Fiches d'identification du zooplankton, No. 30–40. Publiées sous la direction de Dr. P. Jespersen et F. S. Russell. Pp. 44. (Copenhague: Andr. Fred. Høst et fils, 1951.) 12 kr. [210

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United States Department of Commerce: Weather Bureau. Technical Paper No. 15: Maximum Station Precipitation for 1, 2, 3, 6, 12 and 24 Hours, Part 2, Idaho. Pp. 44. (Washington, D.C.: Government Printing Office, 1951.) 25 cents. [410

Indian Central Cotton Committee. Technological Bulletin, Series A, No. 76: Technological Reports on Standard Indian Cottons, 1950. By D. L. Sen. Pp. iv+87. 2 rupees. Technological Bulletin, Series A, No. 77: A Consolidated Report on the Pre-Cleaning and Ginning Tests on Seventeen Varieties of Indian Cottons. By D. L. Sen and V. Venkataraman. Pp. 36. 2 rupees. (Bombay: Indian Central Cotton Committee, 1951.) [410

Smithsonian Miscellaneous Collections. Vol. 116, No. 3: Two Runic Stones, from Greenland and Minnesota. By William Thalbitzer. (Publication 4021.) Pp. ii+71. Vol. 116, No. 5: Middle Cambrian Stratigraphy and Faunas of the Canadian Rocky Mountains. By Franco Rasetti. (Publication 4046.) Pp. v+277+34 plates. (Washington, D.C.: Smithsonian Institution, 1951.) [1010

Kongelige Danske Videnskabernes Selskab. Biologiske Meddelelser. Bind 18, Nr. 13: Studies on Morphological Progression and Evolution in the Vegetable Kingdom. By Tyge W. Böcher. Pp. 51. 4 kr.; 1 dollar. Bind 18, Nr. 17: Phytoplankton Studies, 2, A New Biological Type within the Genus *Chaetoceros*, *Chaetoceros sessilis* sp. nov. By Jul. Grøntved. Pp. 10+1 plate. 1.50 kr.; 50 cents. (København: Ejnar Munksgaard, 1951.) [1010

Kongelige Danske Videnskabernes Selskab. Matematisk-fysiske, Meddelelser. Bind 26, Nr. 10: Synchronisation of Air-jet Generators with an Appendix on the Stem Generator. By Jul. Hartmann and Erik Trudsø. Pp. 39. 5 kr.; 1 dollar. Bind 26, Nr. 11: The Air-jet Generator as a means for setting up Waves in a Liquid Medium. By Jul. Hartmann and F. Larris. Pp. 26. 3 kr.; 75 cents. (København: Ejnar Munksgaard, 1951.) [1010

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